DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. III to VIII SEMESTER

CURRICULUM FOR THE ACADEMIC YEAR

2022-23 to 2026-27

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

B.E in Respective Branch Name Scheme of Teaching and Examination 2022

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

(Effective from the academic year 2023-24)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Weeks				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration in Hours	SEE Marks	CIE Marks	Total Marks	
					L	T	P	S					
1	PCC	22MATE31	Engineering Mathematics-III	Mathematics	3	0	0	-	03	50	50	100	3
2	IPCC	22EC32	Electronics Circuits	E & CE	3	0	2	-	03	50	50	100	4
3	IPCC	22EC33	Networks and Control Systems	E & CE	3	0	2	-	03	50	50	100	4
4	PCC	22EC34	Digital Electronics	E & CE	3	0	0	-	03	50	50	100	3
5	PCCL	22ECL35	Digital Electronics Lab	E & CE	0	0	2	-	03	50	50	100	1
6	ESC	22EC36A	Signals and Systems	E & CE	3	0	0	-	03	50	50	100	3
7	UHV	22UHV37	Social Connect and Responsibility	E & CE	0	0	2	-	02	50	50	100	1
8	AEC	22ECAE381	Fundamentals of Computer System and Office		If the Course is a Theory				02	50	50	100	1
					0	2	0	-					
					If the course is a Laboratory				03				
					0	0	2	-					
9	NCMC	22NS39	Mandatory Course	NSS Coordinator	0	0	2	-	-	50	-	50	0
		22PE39	Mandatory Course	Physical Education Director									
		22YO39	Mandatory Course	Yoga Teacher									
									Total	**450**	**400**	**850**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

Engineering Science Course (ESC/ ETC/ PLC) [L-T-P:3-0-0]			
22EC36A	Signals and Systems	22EC36C	Semiconductor Devices
22EC36B	Transmission Lines and Waveguides	22EC36D	Power Electronics
Ability Enhancement Course –III			
22ECAE381	Fundamentals of Computer System and Office	22ECAE382	Computer organization

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. Form the regulation governing the Degree of Bachelor of Engineering/ Technology (B.E. / B. Tech.) 2022-23 may please be referred.

National Service Scheme /Physical Education/ Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semesters to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall Not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

B.E in Respective Branch Name Scheme of Teaching and Examination 2022

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

(Effective from the academic year 2023-24)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Weeks				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration in Hours	SEE Marks	CIE Marks	Total Marks	
					L	T	P	S					
1	PCC	22EC41	Analog and Digital Communication	E & CE	3	0	0	-	03	50	50	100	3
2	IPCC	22EC42	Embedded Microcontrollers	E & CE	3	0	2	-	03	50	50	100	4
3	IPCC	22EC43	Digital Design using Verilog HDL	E & CE	3	0	2	-	03	50	50	100	4
4	PCCL	22ECL44	Analog and Digital Communication lab	E & CE	0	0	2	-	03	50	50	100	1
5	ESC	22EC45A	Principles of Electromagnetics	E & CE	3	0	0	-	03	50	50	100	3
6	BSC	22BSC46	Biology for engineers	E & CE	3	0	0	-	02	50	50	100	3
7	UHV	22UHV47	Universal Human Values	E & CE	2	0	0	-	02	50	50	100	1
8	AEC	22ECAE481	MATLAB for Engineers	E & CE	If the Course in Theory 0 If the Course in Laboratory 0	2 0	0 2	- -	03	50	50	100	1
9	NCMC	22NS49	Mandatory Course	NSS Coordinator	0	2	2	-	-	50	-	50	0
		22PE49	Mandatory Course	Physical Education Director									
		22YO49	Mandatory Course	Yoga Teacher									
									Total	**450**	**400**	**850**	**20**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S=SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course: The course is not common to all the departments and it is relevant to the respective departments.

Engineering Science Course(ESC/ETC/PLC)[L-T-P::3-0-0]			
22EC45A	Principles of Electromagnetics	22EC45B	Communication Switching Circuits
Ability Enhancement Course /Skill Enhancement Course IV			
22ECAE481	MATLAB for Engineers		

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering/ Technology (B.E/ B. Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semesters to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

Course Name: Engineering Mathematics-III(Electrical & Electronics Engineering Stream)			
Course Code	22MATE31	Semester	3
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- Z-transforms, Fourier Series, Fourier transforms and and its application in engineering fields
- Probability distribution of discrete and continuous random variables
- Joint probability distributions and discrete and continuous random variables

Modules-1	**Teaching Hours**
Difference equations and Z-Transforms : Difference equations –Basic definitions, Z Transform-Definitions, standard Z-transform, linearity property, damping rule, shifting rule , initial value theorem ,final value theorem. Inverse Z-Transform and applications.	**09**
Modules-2	
Fourier series: Periodic functions, Fourier series with periods $(0, 2\pi)$, $(-\pi, \pi)$, $(0, 2l)$ and $(-l, l)$. Half range Fourier series, Practical harmonic analysis and problems.	**08**
Modules-3	
Fourier Transform: Finite and Infinite Fourier transforms, Fourier sine and cosine transforms, properties, Inverse Fourier transforms and problems	**09**
Modules-4	
Probability distributions: Random variable (Discrete and continuous) p.d.f., c.d.f., Binomial distribution, Poisson distributions, Normal distribution and problems	**08**
Modules-5	
Joint probability distributions: Concept of joint probability distribution, discrete and continuous random variables independent random variables .problems on expectation and variance	**08**

Question paper pattern:

- The question paper shall have five modules 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 Higher Engineering Mathematics by B.S.Grewal, Khanna publishers; 40th Edition.2007

2 Engineering Mathematics by N. P. Bali and Manish Goyal. Laxmi publications, latest edition

Reference books:

1.Advanced Engineering Mathematics by E. Kreyszig, John Willey & sons 8th Edn.

2.A short course in differential equations – Rainvile E.D.9th Edition.

3.Advanced Engineering Mathematics by R.K.Jain & S.R.K Iyengar; Narosa publishing House.

4.Introductory methods of numerical analysis by S.S.Sastry

4. Statistical Methods Authored By Gupta S.P. Publisher: Sultan Chand & Sons. Publishing Year: 2021

5. Fundamentals of Mathematical Statistics Authored By Gupta S.C.& Kapoor V.K.Publisher: Sultan Chand & Sons. Publishing Year: 2020

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)
22MATE31C	CO1	Understanding the characteristics and properties of the Z-transform
	CO2	Construction of Fourier series for periodic signals and Fourier series to analyze circuits.
	CO3	Determine Fourier transformation for continuous time signals and systems
	CO4	Solve problems using theoretical probability distributions
	CO5	Apply the concepts of joint probability, to find covariance, correlation, independent variables

Course Name: Electronic Circuits			
Course Code	22EC732	Semester	3
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (10-12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

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

Modules-1	Teaching Hours
Diode characteristics: Introduction, load line analysis, diode approximations, series diode configurationwith DC inputs, parallel and series configurations, **Diodes applications**: AND / OR gates, rectifiers with filter, clippers, clampers, zener diodes as regulators and voltage multiplier circuits.	8
Modules-2	
Bipolar Junction transistor: Introduction, transistor construction, configurations and input outputcharacteristics, **Transistor biasing:** operating point, fixed bias circuit, emitter stabilized bias circuits and voltage dividerbias analysis. **Small signal analysis:** BJT transistor modeling and hybrid equivalent model of small signal amplifier configuration and deriving voltage gain, input impedance and output impedance.	9
Modules-3	
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.	9
Modules-4	
Linear operational amplifier Applications: 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 **Non linear operational amplifier Applications:** Monostable and astable multi vibrators, comparators,Schmitt trigger using operational-amplifier.	8
Modules-5	
Timers: Basic timer circuit, 555 timer used as monostable and astable multivibrators, **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.	8

Question paper pattern:

- The question paper shall have five modules 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. Robert L Boylestad, "Electronic Devices and Circuit Theory", 6 th edition 1999. PHI.
2. Miliman Halkias, "Electronic Devices and circuits", TMH
3. Muhammad H Rashid,"Power Electronics", 2 nd edition 2004, PHI

Reference Books:

1. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 6 th Edition, Oxford University Press, 2010.
2. David A.Bell, "Electronic Devices and Circuits", 5 th editon 2010, Oxford Higher Education 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)
22EC32	CO1	Analyze and apply diode circuits for various applications.
	CO2	Design and analyze transistor biasing circuits and amplifiers.
	CO3	Analyze FET biasing circuits and amplifiers
	CO4	Analyze feedback amplifiers and design oscillators.
	CO5	Analyze and apply power devices for various applications.

LIST OF EXPERIMENTS:

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.

22EC32: Electronic Circuits

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

Course Name: Network Analysis and Control Systems			
Course Code	22EC33	Semester	3
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (13) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To apply and analyze various network theorems in solving the problems related to electrical circuits.
- To describe various network parameters and resonant circuits..
- To teach the fundamental concepts of Control systems and mathematical modeling of the system.
- To study the concept of time response and frequency response of the system.
- To teach the basics of stability analysis of the system

Modules-1	Teaching Hours
Network fundamentals and Theorems: Mesh Loop and Node analysis with linear dependent and independent sources for DC and AC networks. Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power transfer and Millman's theorems..	9
Modules-2	
Filter, Resonance and Two port network parameters: Definition of Q, the factor of merit, series resonance, bandwidth of the series resonant circuit, parallel resonance, conditions for maximum impedance. Filters, constant k low pass and high pass filter, Two port Networks: Z, Y, ABCD and Hybrid parameters, their inter-relationships	8
Modules-3	
Basic Ideas of Control Systems, Mathematical Models of Physical Systems: Classification of Control Systems, Open Loop and Closed Loop (in detail), Differential equations of Physical Systems and Transfer Function (and electrical systems) Block Diagram Reduction, Signal Flow Graphs (simple examples).	8
Modules-4	
Time Response of Feedback Control Systems: Standard Test Signals, Step Response for First and Second Order, Impulse Response for First and Second Order, Distinction between Type and Order of the System. Time Domain Specifications for Second Order System. tr, td, ts tp, Mp, Steady State Error Analysis, Error Constants, Kp, Kv, Ka.	8
Modules-5	
Stability Analysis: R-H criteria of Stability, Root Locus criteria and stability analysis, Stability Analysis using Bode Plot.	9

Question paper pattern:

- The question paper shall have five modules 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..

LIST OF EXPERIMENTS:

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

Text Books:

1. M. E. Van Valkanberg, "Network Analysis", PHI Third edition,2005
2. I J Nagrath and M Gopal, Control systems and Engineering, New Age Publishers 6 th Edition-2017.
3. K Ogata, Modern Control Engineering, PHI 3 rd Edition-2001

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,
3. 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)
22EC33	CO1	Analysis of circuits by using different theorems.
	CO2	Analysis of resonance circuits, constant k-filters and different two port network.
	CO3	Analyze physical systems using differential equations, block diagrams and signal flow graphs.
	CO4	Analyze time response of first and second order systems.
	CO5	Construct the root locus, bode plot and analyze the stability of the system in time domain.

22EC33 (IPCC): NETWORK ANALYSIS AND CONTROL SYSTEMS

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analysis of circuits by using different theorems.	3	2	1			1	1	2	3	2			3	2	2
CO2	Analysis of resonance circuits, constant k-filters and different two port network.	3	2	1			1	1	2	3	2			3	2	2
CO3	Analyze physical systems using differential equations, block diagrams and signal flow graphs.	3	3	2					1		1		1	3	2	2
CO4	Analyze time response of first and second order systems.	3	3	2					1		1		1	3	2	2
CO5	Construct the root locus, bode plot and analyze the stability of the system in time domain.	3	3	2		2			1		1		1	3	2	2
Average		**3**	**2.6**	**1.6**		**2**	**1**	**1**	**1.4**	**3**	**1.4**		**1**	**3**	**2**	**2**

Course Name: Digital Electronics			
Course Code	22EC34	Semester	3
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

- Learn simplification of Boolean expressions, Combinational logic Design
- Learn design of Combinational circuits using MSI ICs.
- Learn design of Sequential circuits.
- Gain understanding of Analysis of Sequential circuits
- Learn fundamentals of Microprocessors.

Module-1	Teaching Hours
Combinational Logic Design: Introduction, Review of Boolean Algebra and Logic gates, Standard Representations for Logical Functions, Minimization of Logical Functions and realisation using gates - K-maps (upto 5 variables), Quine-McCluskey technique, VEM technique. Design examples(with gate realisation)-Arithmetic circuits, Adder with Look-Ahead Carry, BCD-to-7-segment Decoder.	10
Module-2	
Combinational Logic Design using MSI circuits: Multiplexers-Design examples, Applications, Mux Tree, Demultiplexers/Decoders-Design, Applications, BCD Adder, Digital Comparator, Code Converters-Bin-to-Gray and Gray-to-Binary, Priority Encoders: Decimal-to-BCD, Decoder/Driver for Display: BCD-to-7-segment Decoder/Driver.	8
Module-3	
Sequential Circuits : Introduction, A 1-bit memory Cell, Clocked S-R Flip-Flop, J-K FF, D-FF, T-FF. Excitation Table of FFs, Clocked FF Design, Edge-triggered FFs. Registers, Applications of Shift Registers-Ring Counter, Twisted-Ring Counter, Sequence Generator.	8
Module-4	
Sequential Circuits: Ripple/Asynchronous Counters-Design examples using T-FFs, JK-FFs, examples using MSI ICs-7493, 7490. Synchronous Counters-Design examples using FFs, Clocked Sequential Circuit Design, Analysis of Synchronous sequential circuits.	8
Module-5	
Fundamentals of Microprocessors: Introduction, An ideal MP, D-Bus, A-Bus, C-Bus, MP based System-Basic operation, MP operation, MP Architecture, Instruction Set,	8

The 8085A MP, The 8086MP, Programming Languages.	

Question paper pattern:

- The question paper shall have five modules 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. R.P.Jain, " Modern Digital Electronics" 3th Edition, Tata McGraw-Hill Publ. Co. Ltd.
2. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

Reference Books:

1. M.Morris Mano,"Digital Design",4thEdn, PHI Pvt. Ltd,2008
2. Morris and Miller."Designing with TTL integrated circuits", McGrawHill
3. Fletcher, "An Engineering approach to Digital Design", PHI
4. Kohavi, "Switching and Finite Automata Theory",TMH

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

Course Code	CO #	Course Outcome (CO)
22EC34	CO1	Apply different methods for simplification of Boolean expressions and realize using gates.
	CO2	Design and realize Combinational circuits using MSI ICs.
	CO3	Design and realize sequential circuits.
	CO4	Analyse Asynchronous sequential circuits.
	CO5	Analyse Microprocessor based systems

22EC34 : 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 for simplification of Boolean expressions and realize using gates.	3	2	3					1		1		1	3	3	2
CO2	Design and realize Combinational circuits using MSI ICs.	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 Asynchronous sequential circuits.	3	3	3					1		1		1	3	3	2
CO5	Analyse Microprocessor based systems	1	1	2					1		1		1	3	3	2
Average		2.6	2.4	2.8					1		1		1	3	3	2

Course Name: Digital Electronics Laboratory			
Course Code	22ECL35	Semester	3
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	(12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Practical		

Course objectives:

- Learn design, realize and practically implement Combinational logic circuits
- Learn design, realize and practically implement Combinational logic circuits-MSI ICs
- Learn design, realize and practically implement Sequential logic circuits-Counters
- Learn design, realize and practically implement Sequential logic circuits-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 realization of 2-bit, 3-bit and 4-bit ripple counters.
9. Design and implementation of synchronous counters.
10. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops.
11. Realization of ring counters using 7495 ICs.

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)
22ECL35	CO1	Simplification of Boolean expressions and realization using gates.
	CO2	Design and realize Combinational circuits using MSI ICs.
	CO3	Design and realize Ripple/Asynchronous Counters.

	CO4	Design and realize Synchronous Counters.
	CO5	Design and realize Sequential circuits using Shift Registers.

22ECL35 : Digital Electronics Lab

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Simplification of Boolean expressions and realization using gates.	2	2	1			1	1	2	3	2		1	3	2	2
CO2	Design and realize Combinational circuits using MSI ICs.	3	3	1			1	1	2	3	2		1	3	2	2
CO3	Design and realize Ripple/Asynchronous Counters.	3	3	1			1	1	2	3	2		1	3	2	2
CO4	Design and realize Synchronous Counters.	3	3	1			1	1	2	3	2		1	3	2	2
CO5	Design and realize Sequential circuits using Shift Registers.	3	3	1			1	1	2	3	2		1	3	2	2
Average		2.6	2.8	2.8	1			1	1	2	3	2		1	3	2

Course Name: Signals and Systems			
Course Code	22EC36A	Semester	3
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

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.

Modules-1	Teaching Hours
Introduction: Continuous-Time and Discrete-Time signals, Transformation of the independent variable, exponential and sinusoidal signals, the unit impulse and unit-step functions, Continuous-Time and Discrete-Time systems, basic system properties.	**8**
Modules-2	
Linear Time-Invariant Systems: Discrete-time LTI systems, the convolution sum, continuous-time LTI systems, convolution integral, properties of LTI systems, causal LTI systems described by differential and difference equations, singularity functions.	**8**
Modules-3	
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.	**9**
Modules-4	
Representation of aperiodic signals: Continuous-Time Fourier transform, the Fourier transform of periodic signals, properties Continuous-Time Fourier transform, the convolution and multiplication property, duality, the Discrete-Time Fourier transform, the Fourier transform of periodic signals, properties of Discrete-Time Fourier transform, the convolution and multiplication property, duality.	**9**
Modules-5	
Sampling: Representation Continuous-Time signals by its samples, the sampling theorem, Reconstruction of a signal from its samples using interpolation, aliasing. **Z-Transform:**The Z-Transform, region of convergence (ROC) and its properties, inverse Z-transform, properties of Z-transform, analysis and characterization of LTI systems using Z-Transforms, unilateral Z-transform.	**8**

Question paper pattern:

- The question paper shall have five modules 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. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson Education, 2007.

Reference Books:

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001
2. Miichael J Roberts, Govind Sharma, "Fundamentals of Signals and Systems", 2nd Edition, McGrawHill 2010
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005

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)
22EC36A	CO1	Analyze different signals and operations on signals.
	CO2	Analyze LTI systems and determine properties of LTI systems.
	CO3	Analyze Continuous-Time signals in Fourier Domain
	CO4	Analyze Discrete-Time signals in Fourier domain.
	CO5	Analyze Discrete-Time signals using Z-Transform.

22EC36A : Signals and Systems

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

Course Name: Fundamentals of Computer System and Office			
Course Code	22ECAE381	Semester	3
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	50
Credits	1	Exam Hours	03
Examination Type (SEE)	Practical		

Course objectives:

- To acquire basic knowledge about computer hardware and software.
- To be able to create documents for printing and sharing using MS-Word.
- To be able to create and share presentations using MS-PowerPoint.
- To be able to manage and store data in a spreadsheet using Ms-Excel.
- To familiarize the use of Internet and E-mail & computer communication and networks.

Modules-1	Teaching Hours
Introduction to computer and Basic data types Introduction to computer- Characteristics and Basic Applications of Computer, Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Memory, concepts of Hardware and Software, Classifications of computers; Representation of data/Information concepts of data processing, Basic data types, Storage of data/Information as files, operating system and The User Interface (windows, Linux), Windows Setting- Control Panels, Accessories (windows)	**5**
Modules-2	
Basic Word Processing Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats.	**6**
Modules-3	
Basic Presentations Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides	**6**
Modules-4	
Spreadsheets and Basic Data Analysis Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings maintaining invoices/budgets, basic practical data analysis works (Maintaining daily and monthly sales reports)	**6**
Modules-5	
Basic Computer Communication and Internet Basic of Computer networks- LAN and WAN, Internet, Service on Internet; WWW and Web Browsers, Web Browsing software, Surfing the Internet, Chatting on Internet, Email-Basic of electronic mail, Using Emails, Document handling in Email	**5**

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. C.S. French "Data Processing and Information Technology", BPB Publications 1998
2. P.K Sinha, Computer Fundamentals, BPB Publications, 1992

Reference Books:

1. Guy Hart-Davis "The ABCs of Microsoft Office 97 Professional edition", BPB Publications, 1998
2. Karl Schwartz, "Microsoft Windows 98 Training Guide", 1998

E books and online course materials:

1. Word : https://support.office.com/en-US/article/Word-2013-training-courses-videos-andtutorials-14807f76-d2b5-44d6-af11-9c880c44e551?ui=en-US&rs=en-US&ad=US
2. Excel: https://support.office.com/en-US/article/Excel-2013-training-courses-videos-andtutorials-aaae974d-3f47-41d9-895e-97a71c2e8a4a

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

Course Code	CO #	Course Outcome (CO)
22ECAE381	CO1	Describe and work with computer system
	CO2	Work in MS Word for project report drafting & Creating a Newsletter.
	CO3	Develop presentation in MS Power Point for seminar/project interactive presentation
	CO4	Apply formulas in MS Excel, creating charts and graphs to simplify complex information or data.
	CO5	Describe Internet Applications, E-mail Account & its Functions, utility of Search Engine and Surfing Web Pages

22ECAE381 : Fundamentals of Computer System and Office

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe and work with computer system	3	3	3					1				1	3	2	2
CO2	Work in MS Word for project report drafting & Creating a Newsletter.	3	3	3					1				1	3	2	2
CO3	Develop presentation in MS Power Point for seminar/project interactive presentation	3	3	2					1				1	3	2	2
CO4	Apply formulas in MS Excel, creating charts and graphs to simplify complex information or data.	3	3	2					1				1	3	2	2
CO5	Describe Internet Applications, E-mail Account & its Functions, utility of Search Engine and Surfing Web Pages	3	3	2					1				1	3	2	2
Average																

Syllabus IV Semester

Course Name: Analog and Digital Communication			
Course Code	22EC41	Semester	4
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

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

Module-1	Teaching Hours
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 modules 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:

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

Course Code	CO #	Course Outcome (CO)
22EC41	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.

22EC41 : Analog and Digital Communication

CO#	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**

Course Name: Embedded Microcontrollers			
Course Code	22EC42	Semester	4
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + 13 Lab Slots	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

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

Module-1	Teaching Hours
The 8051 Microcontrollers: Micro-controllers and Embedded Processors, Overview of the 8051 Family, Inside the 8051 8051 Programming: Pin diagram, Introduction to 8051 Assembly Programming, Assembling and Running an 8051 Program. The Program Counter and ROM Space in the 8051, Data Types and Directives. 8051 PSW Register, RAM organization, Stack.	8
Module-2	
Addressing Modes, Instruction Sets: Data transfer, Arithmetic, Logical, Bit, Branch instructions. 8051 Timer and Counter Programming: TMOD and TCON register, Programming 8051 Timers, Counter Programming.	8
Module-3	
Interrupt Programming: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in the 8051. Real World Interfacing: 8051 Interfacing to LCD, Keyboard, ADC/DAC, stepper motor.	9
Module-4	
Introduction to Embedded system: Introduction to ARM architecture and Cortex – M4F processor, Cortex M4F architecture, Features.TM4C123GH6PM Block diagram, Features, Applications, TM4C123GH6PM launch pad I/O ports, Address space, On-chip peripherals (analog and digital), Register sets, Addressing modes and Instruction set basics.	7
Module-5	
Microcontroller fundamentals for basic programming: I/O pin multiplexing, pull up/down registers, GPIO control, Programming System registers, Watchdog Timer, QEI. Applications Based on TIVA: LED Blinking, Interrupt programming through GPIO, PWM generation, Interfacing potentiometer (ADC) with TIVA GPIO.	8

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, Create space publications ISBN-13: 978-1477508992

Reference Books:

1. The 8051 Microcontroller, Kenneth Ayala, Second Edition, Thomson,2006
2. The Definitive Guide to ARM® Cortex®-M3, Second Edition, 2017 November, Joseph Yui.
3. CC3100/CC3200 Simple Link™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014–Revised August 2015.

Question paper pattern:

- The question paper shall have five modules 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..

List of Experiments/ Programs

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

Programming Tiva C series TM4Cxx module with CC Studio.

7. Interfacing and Programming GPIO ports in 'C' using Tiva(LED Blinking and Push Button)
8. Interrupt programming through GPIO
9. PWM generation using PWM module on Tiva
10. Interfacing Potentiometer with Tiva GPIO

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

Course Code	CO #	Course Outcome (CO)
22EC42	CO1	Describe the 8051 microcontroller architecture, PSW and memory
	CO2	Analyze the working of 8051 timers and counters and program using 8051.
	CO3	Perform interrupt programming and Interface 8051 with real world I/O devices
	CO4	Describe the architecture of ARM and TM4C microcontroller and program for basic operations
	CO5	Analyze the TM4C modules and Program TM4C to interface real world modules

22EC42: Embedded Microcontrollers

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe the 8051 microcontroller architecture, PSW and memory	3	3	3		3				3			2	3	2	2
CO2	Analyze the working of 8051 timers and counters and program using 8051.	3	3	3		3				3			2	3	2	2
CO3	Perform interrupt programming and Interface 8051 with real world I/O devices	3	3	3		3				3			2	3	2	2
CO4	Describe the architecture of ARM and TM4C microcontroller and program for basic operations	3	3	3		3				3			2	3	2	2
CO5	Analyze the TM4C modules and Program TM4C to interface real world modules	3	3	3		3				3			2	3	2	2
Average		3	3	3		3				3			2	3	2	2

Course Name: Digital Design Using Verilog HDL			
Course Code	22EC43	Semester	4
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + 13 Lab Slots	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

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

Module-1	Teaching Hours
Overview of Digital Design with Verilog HDL: Evolution of CAD, Emergence of HDLs, Typical HDL-flow, Why Verilog HDL?, Trends in HDLs. Top-down and bottom-up design methodology, Lexical conventions, Structure of Verilog HDL module, Levels of abstraction.	7
Modules-2	
Operators and Data types, Dataflow Modelling: Continuous assignments, delay specification, expressions, Structure of Dataflow description, Examples.	8
Modules-3	
Behavioural Modelling**:** Structured procedures, initial and always, blocking and non blocking statements, delay control, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.	9
Modules-4	
Gate-Level Modelling: Modelling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.	7
Modules-5	
Useful Modeling Techniques**:** Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks. Logic Synthesis with Verilog: Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain	9

Text Books:

1. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education, Second Edition.
2. Nazieh M Botros, “HDL Programming – VHDL and Verilog”, Dreamtech Press, 2006 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.

Question paper pattern:

- The question paper shall have five modules 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..

List of Laboratory Experiments

1. Develop a Verilog code for all basic gates in all the modelling styles.
2. Develop a Verilog code for different combinational circuits (half adder, half subtractor, 2:1 multiplexer, 1:2 demultiplexer, 4:2 encoder and 2:4 decoder).
3. Develop a Verilog code for 1-bit full adder and full subtractor in all the modelling styles.
4. Develop a Verilog code for 4-bit full adder and full subtractor.
5. Develop a Verilog code for code conversion (binary to gray, gray to binary, binary to BCD, BCD to binary).
6. Develop a Verilog code for 8-bit, 16-bit and 32-bit ALU.
7. Develop a Verilog code for clock generation.
8. Develop a Verilog code for flip flops (SR, JK, D, T and Master Slave).
9. Develop a Verilog code for 4-bit counters (binary, BCD, Ring, Johnson).
10. Develop a Verilog code for 4-bit Bidirectional Shift Register.
11. Develop a Verilog code for calculation of a factorial of a number using task and function.

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

Course Code	CO #	Course Outcome (CO)
22EC43	CO1	Understand the basics of Verilog HDL Programming
	CO2	Develop programs in Data flow modelling using various data types and operators
	CO3	Develop programs to demonstrate behavioural modelling using conditional statements and loops.
	CO4	Develop programs in gate-level modelling using delays and using tasks and functions
	CO5	Perform timing and delay simulation and interpret the various constructs in logic synthesis.

22EC43: Digital Design Using Verilog HDL

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe the design flow and structure of Verilog HDL Programming	3	2	2	2			2		2		2	3	2	2	3
CO2	Develop programs with Data flow modelling by applying different data types and operators	3	3	3	3			2		2		2	3	3	2	3
CO3	Develop programs to demonstrate behavioural modelling using conditional statements and loops.	3	3	3	3			2		2		3	3	3	3	3
CO4	Develop programs in gate-level modelling using delays and using tasks and functions	3	3	3	3			3		2		3	3	3	3	3
CO5	Perform timing and delay simulation and interpret the various constructs in logic synthesis.	3	3	3	3			2		3		3	3	2	2	3
Average		3	2.8	2.8	2.8			2.2		2.2		2.6	3	2.6	2.4	3

Course Name: Analog And Digital Communication Lab			
Course Code	22ECL44	Semester	4
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	50
Credits	1	Exam Hours	03
Examination Type (SEE)	Practical		

Course objectives:

- To design and Demonstrate Second Order active low pass, high pass and 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 as ASK, PSK, DPSK and FSK
- To Verify and demonstrate PN sequence generation

- Second order active low pass and high pass filter
- Second order active band pass and band elimination filter
- Amplitude modulation and demodulation using envelop detector
- Frequency modulation and demodulation using PLL
- Pre-emphasis and De-emphasis circuits.
- PAM modulation and demodulation
- PPM Modulation and demodulation
- PWM Modulation and demodulation
- Signal sampling and its reconstruction
- Time division multiplexing of signals
- Amplitude shift keying
- Frequency shift keying
- Phase shift keying
- 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 be able to:		
Course Code	**CO #**	**Course Outcome (CO)**
22ECL44	CO1	Design various second order active filters.
	CO2	Design AM, FM and its demodulation.
	CO3	Design and implement Pulse modulation schemes such as AM, PWM and PPM
	CO4	Design and implement ASK, FSK and PSK modulation and demodulation.
	CO5	Design and implement PN sequence generator.

22ECL44: ANALOG AND DIGITAL COMMUNICATION LAB

CO#	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 and implement Pulse modulation schemes such as AM, PWM and PPM	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 various second order active filters.	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

Course Name: Principles Of Electromagnetics			
Course Code	22EC45A	Semester	4
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

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

Modules-1	Teaching Hours
Preliminaries: Vector analysis and coordinate transformation: vector algebra, coordinate systems, vector components, unit vector, dot &cross products. Cylindrical and spherical, coordinate system, coordinate transformations. **Coulomb's law electric field intensity**: Experimental coulombs law, electric field intensity, electric field due to continuous volume charge, line charge, sheet charge. Electric flux density, Gauss law and Divergence: electric flux density, Gauss law and its applications, divergence theorem	9
Module-2	
Energy and potential: Energy and potential in a moving point charge in an electric field, line integral, potential difference and potential, potential field of a point charge, The potential field of a system of charges- conservative property, potential gradient, the dipole, energy density in electric field. **Conductors, dielectric and capacitance**: Current and current density, continuity of current, Metallic conductors, conductor properties and boundary conditions, Capacitance, several capacitance examples. Capacitance of a two- wire line	8
Module-3	
Poisson's and Laplace's equation: Poisson's and Laplace's equations, Uniqueness theorem, solution of Laplace's equation, examples of solutions of Poisson's equations. **Magnetic Fields:** Steady Magnetic fields: Biot savart's law, Ampere's circuital law, Curl. Stokes theorem, magnetic flux and flux density, Magnetic forces, material and inductances: Scalar and vector magnetic potentials, magnetic force between differential current elements, force and torque on a closed circuit, magnetic boundary conditions , magnetic circuit, inductance.	8
Module-4	
Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equations in point form and integral form, the retarded potentials. **Uniform plane wave**: Wave propagation in free space, wave propagation in dielectrics, The Poynting vector& power considerations, propagation in good conductors-skin effect, wave polarization, the distortion less line.	9
Module-5	
Plane waves at boundaries & in dispersive media: Reflection of uniform plane waves at normal incidence, standing wave ratio, wave reflection from multiple interfaces, plane wave propagation in general directions, plane wave reflection at oblique incidence angles,	8

plane wave propagation in dispersive media.	

Question paper pattern:

- The question paper shall have five modules 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,TMH7thed.

Reference Books:

1. Kraus J D and Carver K R., electromagnetic.,(TMH)
2. JA r. Edminister, electromagnetic, TMH 2nd ed.
3. P.N.O Sadiku,"Elementsofelectromagnetic"4th ed. Oxford University press.
4. E C Jordon & K G . Balmain., electromagnetic waves and radiation system., PHI2nd ed.Hayt. W. H. & J. E. Kemmerly, "Engineering Circuit Analysis", TMH Eighth edition JA r. Edminister, electromagnetic, TMH 2nd ed.

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)
22EC45A	CO1	Compute electric field intensity & potential using Coulomb's law & Gauss's law.
	CO2	Analysis of EM field using boundary conditions
	CO3	Analysis of steady magnetic fields.
	CO4	Analysis of time varying fields using Maxwell's equations and wave propagation in different media.
	CO5	Analysis of wave reflection in different media

22EC45A: Principles of Electromagnetics

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Compute electric field intensity & potential using Coulomb's law & Gauss's law.	3	3	2					1		1		1	3	2	2
CO2	Analysis of EM field using boundary conditions	3	3	2					1		1		1	3	2	2
CO3	Analysis of steady magnetic fields.	3	3	2					1		1		1	3	2	2
CO4	Analysis of time varying fields using Maxwell’s equations and wave propagation in different media.	3	3	2					1		1		1	3	2	2
CO5	Analysis of wave reflection in different media	3	3	2					1		1		1	3	2	2
Average		3	3	2					1		1		1	3	2	2

Course Name: Biology For Engineers			
Course Code	22BSC46	Semester	4
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To familiarize the students with the basic biological concepts and their engineering applications.
- To enable the students with an understanding of bio design principles to create novel devices and structures.
- To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- To motivate the students to develop interdisciplinary vision of biological engineering.

Module-1	Teaching Hours
INTRODUCTION TO BIOLOGY: The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cell s and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions),vitamins and hormones	8
Module-2	
BIOMOLECULES ANDTHEIR APPLICATIONS(QUALITATIVE): Carbohydrates(cellulose- based water filters, PHA and PLA as bioplastics), Nucleicacids(DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics– DNA finger printing), Proteins(Proteins as food– whey protein and meat analogs, Plant based proteins), lipids(biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).	8
Module-3	
HUMAN ORGAN SYSTEMS AND BIODESIGNS(QUALITATIVE): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system(architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signaling -ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pacemakers, defibrillators). Lungs as purification system(architecture, gas exchange mechanisms ,spirometry, abnormal lung physiology-COPD, Ventilators, Heart-lung machine). Kidney as a filtration system(architecture, mechanism of filtration, CKD, dialysis systems).	9
Module-4	
NATURE-BIO INSPIRED MATERIALS AND MECHANISMS(QUALITATIVE): Echolocation (ultra sonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying(GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs(Velcro), Shark skin(Friction reducing swim suits), Kingfisher beak(Bullet train). Human Blood substitutes-hemoglobin- based oxygen carriers(HBOCs) and per flouro carbons(PFCs).	8

Module-5	
TRENDS IN BIO ENGINEERING(QUALITATIVE): Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bio engineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bio printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Bio computing, Bio imaging and Artificial Intelligence for disease diagnosis. Self-healing Bio concrete(based on bacillus spores, calcium lactate nutrients and bio mineralization processes) and Bioremediation and Bio mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).	9

Suggested Learning Resources: Books

- Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W.,Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning(Suggested Activities in Class)/Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system

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

Course Code		Course Outcome (CO)
22BSC46	CO 1	Elucidate the basic biological concepts via relevant industrial applications and case studies.
	CO 2	Evaluate the principles of design and development, for exploring novel bioengineering projects.
	CO 3	Corroborate the concepts of bio mimetics for specific requirements.
	CO 4	Think critically towards exploring innovative bio based solutions for socially relevant problems
	CO 5	

22BSC46: BIOLOGY FOR ENGINEERS

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Elucidate the basic biological concepts via relevant industrial applications and case studies.															
CO2	Evaluate the principles of design and development, for exploring novel bioengineering projects.															
CO3	Corroborate the concepts of bio mimetics for specific requirements.															
CO4	Think critically towards exploring innovative bio based solutions for socially relevant problems															
Average																

Course Name: MATLAB For Engineers			
Course Code	22ECAE481	Semester	4
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	50
Credits	1	Exam Hours	03
Examination Type (SEE)	Practical		

Course Objectives:

- The objectives of the course is to enable students to:
- Write MATLAB programs using built in functions.
- Write code to sketch plots.

Module-1	Teaching Hours
Introduction, basic features, a minimum MATLAB session, getting started	5
Module-2	
Mathematical functions, basic plotting, matrix generation	5
Module-3	
Array operations, solving linear equations, matrix functions	6
Module-4	
Introduction to programming in Matlab, M-file scripts, M-file functions, input to a script file, output commands.	6
Module-5	
Control flow and operators, saving output to a file, debugging M-files	6

Question paper pattern:

- The question paper shall have five modules 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. David Houcque, " Introduction To Matlab For Engineering Students"

Reference Books:

1. Brian H Hahn, Daniel T Valentine, "Essential MATLAB for Engineers and scientists"

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21ECAE481	CO1	Start using MATLAB
	CO2	Use mathematical functions and plot
	CO3	Use array functions and matrix functions
	CO4	Do programming using MATLAB
	CO5	Use flow control functions and know how debug.

22ECAE481: MATLAB For Engineers

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Start using MATLAB	2	2	1			1	1	2	3	2		1	3	2	2
CO2	Use mathematical functions and plot	3	3	1			1	1	2	3	2		1	3	2	2
CO3	Use array functions and matrix functions	3	3	1			1	1	2	3	2		1	3	2	2
CO4	Do programming using MATLAB	3	3	1			1	1	2	3	2		1	3	2	2
CO5	Use flow control functions and know how debug.	3	3	1			1	1	2	3	2		1	3	2	2
Average		2.6	2.8	2.8	1			1	1	2	3	2		1	3	2

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

B.E in Electronics & Communication Engineering 2022

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

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

(Effective from the academic year 2023-24)

V Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Weeks				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22EC51	Antenna and Microwave Engineering	E & CE	4	0	0	-	04	50	50	100	4
2	IPCC	22EC52	Digital Signal Processing	E & CE	3	0	2	-	03	50	50	100	4
3	IPCC	22EC53	Data Structure and Algorithm	E & CE	3	0	2	-	03	50	50	100	4
4	PCCL	22ECL54	Antenna and Microwave Lab	E & CE	0	0	2	-	03	50	50	100	1
5	PEC	22EC55X	PEC-I	E & CE	3	0	0	-	03	50	50	100	3
6	PROJ	22ECMP56	Mini-Project	E & CE	0	0	2	-	03	50	-	50	2
7	RMI	22RMI57	Research Methodology and IPR	E & CE	3	0	0	-	03	50	50	100	3
8	ESC	22ES58	Environmental Studies	E & CE	3	0	0		03	50	50	100	2
9	NCMC	22NS59	Mandatory Course	NSS Coordinator	0	0	2	-	-	50	-	50	0
		22PH59	Mandatory Course	Physical Education Director									
		22YO59	Mandatory Course	Yoga Teacher									
									Total	**450**	**350**	**800**	**23**

Professional Elective Course(PEC-I)

PEC-22EC551	IOT and its application
PEC-22EC552	Analog CMOS VLSI Design

PCC: Profession core Course, **PCCL:** Professional Core Course Laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course(Non-Credit), **AEC:** Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K:** The letter in the course code indicates common to all the stream of engineering. **PROJ**: Project/Mini Project. **PEC**: Professional Elective Course. IPCC: Integrated Professional Core Course

Antenna and Microwave Engineering			
Course Code	22EC41	Semester	5
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of basic concepts of antenna theory.
- To impart knowledge of Identify antenna types for specific applications.
- To impart knowledge of basic concepts of Active& Passive Devices.

Modules	Teaching Hours
Module-1	
Introduction to Antenna: Principle of radiation, isotropic radiator, radiation resistance, radiation pattern, beam width, bandwidth, directivity, gain, effective length of an antenna, relationship between gain and radiating efficiency, power gain, Frii's transmission formula.	10
Module-2	
Antenna arrays: Point sources, two element arrays of equal amplitude and same phase, equal amplitude and opposite phase and unequal amplitude and any phase, broad side and end fire arrays, multiplication of patterns, Binomial arrays, Effect of earth on vertical pattern	10
Module-3	
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	11
Module-4	
Microwave waveguides and components: Introduction, hybrid circuits, directional couplers, circulators, magic tee and isolators, phase shifters, attenuators, s-matrix representation of multiport networks.	10
Module-5	
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.	11

Text Books:

1. Antennas and wave propagation – John D Krauss,Ronald J Marhefka, Ahmed Khan, 4th Edition.Mcgraw Hill Education 2013.
2. Antenna and wave propagation – K. D. Prasad, Satyaprakashan Publishers,2012
3. Microwave Engineering –AnnapurnaDas, Sisir K Das, TMH publication, 2nd edition 2010.
4. Microwave Devices and Circuits – Samuel Y Liano, Pearson education.

Reference Books:

1. Antenna and wave propagation- Harish and Sachidananda, oxford university press 2007.
2. Antenna theory analysis and design,C A Balanis, Third Edition, Wiley
3. Microwave Engineering- David M Pozar, John Wiley India Pvt Ltd, 3rd edition.
4. Microwave Engineering- Sushrut Das, Oxford Higher Education 2nd edition 2015.

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)**
22EC51	CO1	Analyze various Antenna parameters and their significance.
	CO2	Analyze and understand the concepts of Antenna Arrays.
	CO3	Identify various Antenna Configurations for suitable applications.
	CO4	Understand the basic concepts & functional characteristics of passive devices .
	CO5	Understand the basic concepts & functional characteristics of Active devices.

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 various Antenna parameters and their significance	3	2						1				1	3		
CO2	Analyze and understand the concepts of Antenna Arrays	3	3	2	2				1		1		1	3	2	2
CO3	Identify various Antenna Configurations for suitable applications	3	2	2	2				1		1		1	3	2	2
CO4	Understand the basic concepts & functional characteristics of passive devices	2	1	1	1				1				2	3	1	1
CO5	Understand the basic concepts & functional characteristics of Active devices.	2	1	1	1				1				2	3	1	1
Average		2.6	1.8	1.2	1.2				1		0.4		1.4	2	3	1.2

Course Name: Digital Signal Processing			
Course Code	22EC52	Semester	5
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (10-12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

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

Modules	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 Transformers.	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 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.

List of Laboratory Experiments (2 Hours/Week/Batch) Batch Strength: 15

1. Introduction to MATLAB
2. Verification of sampling theorem

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

Reference Books:

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

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
22EC52	CO1	Compute the Discrete Fourier Transform (DFT) of a sequence.
	CO2	Analyze the efficient computation of DFT using Fast Fourier Transform.
	CO3	Design FIR filters using Windows and frequency sampling Technique.
	CO4	Design digital IIR filters from Analog filters.
	CO5	Realize digital filters using network structures.

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	Compute the Discrete Fourier Transform (DFT) of a sequence.	3	2	2	2	2			1		1		1	3	3	2
CO2	Analyze the efficient computation of DFT using Fast Fourier Transform.	3	2	2	2	2			1		1		1	3	3	2
CO3	Design FIR filters using Windows and frequency sampling Technique.	3	2	3	2	2			1		1		1	3	3	2
CO4	Design digital IIR filters from Analog filters	3	2	3	2	2			1		1		1	3	3	2
CO5	Realize digital filters using network structures.	3	2	2	2	2			1		1		1	3	3	2
Average		3	2	2.4	2.4	2			1		1		1	3	3	2

Course Name: Data Structures and Algorithms Using Python			
Course Code	22EC53	Semester	5
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (10-12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- Understand the basic of python programming
- Introduce the fundamentals of Data Structures
- Understand the algorithms
- Gain knowledge of linear and nonlinear data structures
- Understand the searching and sorting techniques.

Modules	Teaching Hours
Module-1	
Introduction: The Python environment, Variables and expressions,Variable scope, operators, expressions, Membership, identity and logical operations, **Built-in data types**Flow immutable sets, control and iteration Sequences, Strings, Lists, Tuples, Functions, Recursive functions, Sets, Arrays. Introduction to object orientated programming paradigm, Classes and object programming, Special methods, Inheritance, Data encapsulation and properties, Namespaces.	9
Module-2	
Introduction to Data Structures: Types of Data Structure, Primitive Data Types Algorithms: Time and Space Complexity of Algorithms **Arrays:** Array Initialization, Definition of Array, Characteristic of Array, One-dimensional Array, Two-dimensional Array **Linked Lists:**Singly linked lists, Singly linked list class, operations on list, list traversal, Deleting nodes, List search Clearing a list , Doubly linked lists, operations on doubly linked lists, Circular lists, Appending elements, Deleting an element, Iterating through a circular list.	9
Module-3	
Stacks, Stack implementation, Stack operations, Application of stack, **Queues**, List-based queue, Queueoperations, Stack-based queue, Application of queues.	8
Module-4	
Trees, Terminology, Tree nodes, **Binary trees,** Binary search trees, Binary search tree implementation,Binary search tree operations, Finding the minimum and maximum nodes, Inserting nodes, Deleting nodes, Searching the tree, tree Traversal, Heaps.	8
Module-5	
Searching & Sorting Techniques: Introduction, Objectives and search techniques, linear and binary search. Sorting techniques: Introduction, Bubble Sort, Insertion Sort, Radix Sort, Selection Sort, Quick Sort **Hashing Techniques:** Hash function, Address calculation techniques, Common hashing functions Collision resolution, Linear probing, Quadratic, Double hashing, Bucket hashing, Deletion and rehashing.	8

Text Books:

1. Benjamin Baka, “Python Data Structures and Algorithms”, Packt Publishing, 2017
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser , “Data Structures and Algorithms in Python”

Reference Books:

1. Rance D. Necaise , “Data Structures and Algorithms Using Python”
2. David L. Ranum and Bradley N. Miller , “Problem-Solving with Data Structures and Algorithms”

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.

List of Laboratory Experiments (2 Hours/Week/Batch) Batch Strength: 15

1	Python program to show how to create a Python List and some of its operations
2	Python program to show how to create a Python Tuple and to access its elements
3	Creating a bytearray
4	Python program to show the implementation of the linked list Creating a node class Creating a linked list class Printing the linked list
5	Python programs to show linked list operations Creating a node class Creating a linked list class Inserting a node at the beginning of the list Inserting a node after a particular node Inserting the node at the end of the list Deleting a particular node Searching an element in the list Sorting the linked list Printing the linked list
6	Python program to show how to create a stack and implement the operations Creating a stack To check if it is an empty stack Adding new elements to the stack Eliminating an item from the stack
7	Python program to create a queue and implement operations of a queue Creating a class for queue Adding an element to the queue Removing an element to the queue
8	Python program to implement a heap data structure in Python Defining a method to create a heap
9	Python program to show how to create a binary tree and traverse it in Python Creating a class for a Node of the tree Method to transverse in a pre-order manner Method to transverse in an in-order manner Method to transverse in an post-order manner
10	Python program to implement Bubble Sort Algorithm
11	Python program to implement Selection Sort
12	Python program to perform Quick Sort Algorithm and Binar sort

Course Code	CO #	Course Outcome (CO)
22EC53	CO1	Develop Python programs to implement various data structures applications
	CO2	Design and analyze basic algorithms and prove their correctness using the appropriate data structure
	CO3	Implementing data structures like Linked Lists, and basic Trees operations.
	CO4	Implementing data structures like Stacks, Queues

	CO5	Implement searching & sorting techniques

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	Develop Python programs to implement various data structures applications	3	3	3		3	2	2	2					3		
CO2	Design and analyze basic algorithms and prove their correctness using the appropriate data structure	3	3	3		2	2	2	2					3		
CO3	Implementing data structures like Linked Lists and basic Trees operations.	3	3	3		2	2	2	2					3	2	2
CO4	Implementing data structures like Stacks, Queues	3	3	3		2	2	2	2					3	2	2
CO5	Implement searching & sorting techniques	3	3	3		3	2	2	2					3	2	2
Average		**3**	**3**	**3**		**2.4**	**2**	**2**	**2**					**3**	**1.2**	**1.2**

Course Name: Antenna & Microwave Lab			
Course Code	22ECL54	Semester	5
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	(13) Lab slots	SEE Marks	50
Credits	1	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

To enable the students to obtain the knowledge of Antenna and MicrowaveLab:

- Study & understand the basic characteristics of Gunn diode and Reflex Klystron.
- Study &Analyze functional characteristics of Passive Devices.
- Learn & understand to draw the radiation pattern of Horn Antenna.
- Learn & understand the design of microstrip patch antennas for wireless applications.

List of experiments of the laboratory to be conducted

1. V-I Characteristics of Gun diode
2. Repeller mode characteristics of reflex klystron.
3. Calibration of attenuator and Measurement of attenuation.
4. Characteristics of directional coupler
5. Characteristics of Isolator.
6. Characteristics of Circulator.
7. Characteristics of magic tree.
8. Radiation pattern of horn antenna.
9. Design and simulation of rectangular microstrip patch antenna with a particular operating frequency, dielectric constant and substrate thickness
10. Design of microstrip patch antenna using microstrip line feeding technique
11. Design of microstrip patch antenna using a coaxial feeding technique
12. Design and simulation of wide band patch antenna

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 Code	CO #	Course Outcome (CO)
22ECL54	CO1	Characterize different modes of operation of active microwave devices like reflex klystron & Gunn diode.
	CO2	Analyze the functional characteristics of passive microwave devices
	CO3	Determine the radiation pattern of Horn antenna
	CO4	Design and simulate rectangular patch antenna using Antenna Design Tool in MATLAB software
	CO5	Design and simulation of patch antenna for different applications antenna using Antenna Design Tool in MATLAB software

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	Characterize different modes of operation of active microwave devices like reflex klystron & Gunn diode.	3	2		2					3			1	3	2	
CO2	Analyze the functional characteristics of passive microwave passive devices	1	2		2					3			1	3	2	
CO3	Determine the radiation pattern of Horn antenna	1	2	2	2					3			1	3	2	
CO4	Design and simulate rectangular patch antenna	1	2	2	2					3			1	3	2	1
CO5	Analyze functional characteristics of devices like directional coupler, power divider using microstrip	1	2	2	1					3			1	3	2	1
Average		1.4	2	2	1.8					3			1	3	2	1

Course Name: Internet of Things & its Application			
Course Code	22EC551	Semester	5
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To study the fundamentals about IoT
- To study about IoT connectivity Technologies
- To study the IoT communication Technologies
- To study theParadigms ,challenges ,Future andHardware platforms
- To study the applications of IoT in industry

Modules	Teaching Hours
Module-1	
FUNDAMENTALS OF IoT- Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.	8
Modules-2	
IoTconnectivity Technologies-Introduction, IEEE 802.15.4,Zigbee,Thread,ISA100.11A,Wireless HART,RFID,NFC,DASH7, Z-WAVE ,Weightless, Sigfox, LORa, NB-IOT ,Wi-Fi, Bluetooth	9
Modules-3	
IoT communication Technologies-Introduction, constrained nodes, networks, types of constrained Devices, low power and lossy networks. **Infrastructure protocols:**Internet protocol Version 6(IPv6), LOADng, RPL, 6LoWPAN, QUIC, Micro internet protocol, Nano internet protocol, Content –centric networking. **Discovery Protocols:** Physical web, multicast DNS, Universal Plug and play. **Data protocols:**MQTT, MQTTSN, CoAP, AMQP, XMPP, SOAP, REST, web socket. Identification protocol ,Device management, semantic protocols	8
Modules-4	
Paradigms,challenges and Future-Introduction ,Evolution of New IoT paradigms, challenges Associated with IoT, Emerging pillars of IoT **Beginning IoT Hardware Project:** Introduction to Arduino Boards, writing an Arduino Sketch, introduction to Raspberry Pi boards,	8
Modules-5	
Industrial Applications:-IoT applications in home, infrastructures, buildings, security, Industries &other IoT electronic equipment, Industry 4.0 concepts.	9

Text Books:

1. Introduction To IoT –SudipMisra, Anandarup Mukherjee, Arijit Roy-Cambridge University Press,2021
2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

Reference Books:

1. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2015
2. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

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.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 40% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Course Code	CO #	Course Outcome (CO) At the end of this course, students will be able to
22EC551	CO1	Describe the basics of IoT.
	CO2	Analyze different IoT protocols.
	CO3	Analyze the design methodology and hardware platforms involved in IoT.
	CO4	Describe techniques to organize the data.
	CO5	Demonstrate IOT Applications in Industrial & real world.

CO-PO-PSO Matrix:

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe the basics of IoT.	3	2	2	2			2				1	3	2	2	3
CO2	Analyze different IoT protocols.	3	2	2	2			2				1	3	3	2	3
CO3	Analyze the design methodology and hardware platforms involved in IoT.	3	2	2	2			2				1	3	3	3	3
CO4	Describe techniques to organize the data.	3	2	2	2			2				1	3	3	3	3
CO5	Demonstrate IOT Applications in Industrial & real world.	3	2	2	2			2				1	3	2	2	3
Average		3	2	2	2			2				1	3	2.6	2.4	3

Analog CMOS VLSI Design			
Course Code	22EC552	Semester	5
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- Describe the basic MOS device physics and models.
- Describe method of the small signal and large signal analysis of amplifiers.
- Understanding the working of single stage MOS amplifiers with analysis.
- Describe the operation of different types of Current mirrors and their applications.
- Analysis and Design of the Operational amplifiers.
- Analysis and design of CMOS oscillators with mathematical model of VCOs

Modules	Teaching Hours
Module-1	
Single– Stage Amplifiers: MOS Device Models, Basic Concepts, Common–Source Stage, Source Follower, Common–Gate Stage, Cascade Stage	8
Modules-2	
Differential Amplifiers: Single– Ended and Differential Operation. Basic Differential Pair, Common–Mode Response, Differential Pair with MOS Loads, Gilbert Cell.	8
Modules-3	
Passive and Active Current Mirrors: Basic Current Mirrors Cascode Current Mirrors, Active Current Mirrors. Frequency Response of Amplifiers: General Considerations: Explore and analyze the Wilson Current mirror. Miller Effect, Association of Poles with Nodes Common source stage Source Followers.	9
Modules-4	
Frequency Response of Amplifiers: Common Gate stage, Cascode Stage and Differential Pair. Operational Amplifiers: General considerations, One stage op-amp, Two stage op-amp, Gain Boosting, Comparison, Common Mode feedback,	9
Modules-5	
Operational Amplifiers: Input Range limitations, Slew rate, Power supply rejection, Noise in Op-amps. Oscillators: General Considerations, Ring Oscillators, LC Oscillators, Voltage–Controlled Oscillators, Mathematical Model of VCOs.	8

Text Books: Text Book(s):

1. Design of Analog CMOS Integrated Circuits", Behzad Razavi, Tata McGraw Hill, Indian Edition, 2008, ISBN:0-07-238032-2.

Reference Books: Reference Book(s):

1."CMOS Analog Circuit Design", Phillip E. Allen, Douglas R. Holberg, Oxford University Press, 3rd edition 2011, ISBN:9780199765072.

2."CMOS Circuit Design, Layout and Simulation", R. Jacob Baker, Harry W. Li, David E. Boyce, Prentice Hall of India, 1st edition 2005, ISBN-13:978-0780334168 ISBN- 10:0780334167.

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.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 40% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Course Code	CO #	Course Outcome (CO) At the end of this course, students will be able to
22EC552	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

CO#	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	2			2				1	3	2	2	3
CO2	Design MOS circuits using stick and layout diagrams.	3	2	2	2			2				1	3	3	2	3
CO3	Analyze CMOS fabrication flow and technology scaling	3	2	2	2			2				1	3	3	3	3
CO4	Analyze CMOS subsystems and architectural issue with the design constraints	3	2	2	2			2				1	3	3	3	3
CO5	Analyze Memory elements and testability issues in VLSI Design	3	2	2	2			2				1	3	2	2	3
Average		3	2	2	2			2				1	3	2.6	2.4	3

Course Name: Mini-Project			
Course Code	22ECMP56	Semester	1
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	-
Credits	2	Exam Hours	03
Examination Type (SEE)	Practical		

Course objectives:

- To impart knowledge for Improve the practical skills
- To impart knowledge to Collect the information of project
- To impart knowledge to select appropriate method
- To impart knowledge of Plan and implement project
- To impart knowledge of 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 Code	CO #	Course Outcome (CO)
22ECMP56	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)

CO-PO-PSO Matrix:															
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

Course Name: Research Methodology & Intellectual Property Rights			
Course Code	22RMI57	Semester	5
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

- 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	9
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.	8
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.	9
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	8

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.	8

Question paper pattern:

• The question paper will have ten questions.

• Each full question consists of 20 marks.

• There will be 2 full questions (with a maximum of four sub questions) from each module.

• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Research Methodology: Methods and Techniques C.R.Kothari, Gaurav Garg New Age International4th 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

E books and online course materials:

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

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
22RMI57	CO1	To know them leaning of engineering research.
	CO2	To know the defining of research problem and procedure of LiteratureReview.
	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

Course Name: Environmental Studies			
Course Code	22ES58	Semester	5
Teaching hours per week (L:T:P:S)	2:0:0:0	CIE Marks	50
Total Hours	28 Hours (Theory)	SEE Marks	50
Credits	2	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

- To creative environmental awareness among the students'
- To gain knowledge on different types of pollution in the Environment

Modules	Teaching Hours
Module -1	
Environment-Definition, components, Ecosystem-Balanced Ecosystem, Structural and functional unit of Ecosystem, Human activities – Economic and Social Security	**5**
Module -2	
Human activities Effects on Environment-Industries, Housing, Agriculture, mining, Transportation, Natural Resources-Water Resources, forest, mineral resources, fluoride problems in Drinking water, water Induced diseases. Deforestation, sustainable mining,	6
Module -3	
Material cycles – Nitrogen, Sulphur, carbon cycle Environmental pollution –ground water pollution, noise pollution, soil pollution, Industrial and Municipal sludge. Air pollution, B.O medical waste E-wastes, Automobile pollution	6
Module -4	
Global Environmental Concerns-Climate change and global warming effects, urbanization, ozone layer depletion, acid rain, current Environmental issues and important, population growth, Environmental toxicology, Biogas energy, solar energy.	6
Module -5	
Objects of Environmental studies, Importance of women's Education, non-government organization (NGO), Green building or water treatment plant, G.I.S and Remote sensing, EIA (Environmental Impact Assessment), Role of Government for protection of Environmental	5

Reference Books:

1. Environmental Studies- Benny Joseph –Tata Megrawhill 2005
2. Environmental Studies-D L Manjunath, P M Dotrad, B.S.Raman
3. Environmental Studies-Geeta Naagbhushan

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

Course Code	CO #	Course Outcome (CO)
22ES58	**CO1**	Understand the Environmental components balance eco systems
	CO2	Develop critical thinking and apply them to the analysis of a problems or question related to Environment
	CO3	Demonstrate Ecology knowledge of a complex relationship between biotic and a biotic components
	CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers phase when dealing with complex issue
	CO5	Understand latest developments in environmental pollution, Mitigation, Tools Concept and applications of G.I.S and Remote sensing.

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

B.E in Respective Branch Name Scheme of Teaching and Examination 2022

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

(Effective from the academic year 2023-24)

VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Weeks				Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawing	Self Study	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	22HU61	EMF	Humanities	3	0	0	-	03	50	50	100	3
2	PCC	22EC62	VLSI Design	E & CE	4	0	0	-	04	50	50	100	4
3	PEC	22EC63x	PEC-II	E & CE	3	0	0	-	03	50	50	100	3
4	OEC	22ECOE64x	OEC-I	E & CE	3	0	0	-	03	50	50	100	3
5	PROJ	22ECP65	Major Project Phase-I	E & CE	0	0	3	-	03	50	-	50	2
6	PCCL	22ECL66	VLSI Design Lab	E & CE	0	0	2	-	03	50	50	100	1
7	AEC/ SDC	22ECIKS67	Indian Knowledge System	E & CE	If the course is offered as theory: 2	0	0	-	02	50	-	50	1
					If the course is offered as practical: 0	0	2	-	02				
8	NCME	22NS68	Mandatory Course	NSS Coordinator	0	0	2	-	-	50	-	50	0
		22PE68	Mandatory Course	Physical Education Director									
		22YO68	Mandatory Course	Yoga Teacher									
									Total	**400**	**250**	**650**	**17**

Professional Elective Course(PEC-II)

22EC631	Wireless Communication	22EC633	Optical Fiber Communication
22EC632	Satellite Communication		

Open Elective Course(OEC-I)

22ECOE641	Soft Computing	22ECOE643	Computer Architecture and Organization
22ECOE642	Automotive Electronics	22ECOE644	Robotics

Ability Enhancement Course/Skill Enhancement Course

22ECIKS67	Indian Knowledge System

Course Name: Entrepreneurship,Management &Finance			
Course Code	22HU61	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- 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 paperpattern:

- 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.

Textbooks:

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. VeerbhadrappaHavina - 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

ReferenceBooks:

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

Ebooksandonlinecoursematerials:

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

Courseoutcomes:

On completion ofthecourse,thestudentwillhavetheabilityto:

CourseCode	CO#	CourseOutcome(CO)
22HU61	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

CO-PO-PSO Matrix:

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	

Course Name: VLSI Design			
Course Code	22EC62	Semester	6
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + 13 Lab Slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge to learn the MOS transistor theory and analyze CMOS technologies
- To impart knowledge of design the combinational and sequential circuit in CMOS technology
- To impart knowledge of concepts of subsystem and illustrate the design processes.
- To impart knowledge of 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.	11
Modules-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.	11
Modules-3	
Basic Circuit Concepts: Sheet resistance. Area capacitances. Capacitancecalculations. The delay unit, Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances. **Scaling of MOS circuits:** Scaling models and scaling factors. Limits on scaling.	10
Modules-4	
Subsystem Designs: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) **Subsystem Design Processes:** Some General considerations, An illustration of Design Processes.	10
Modules-5	
Memory, Registers and Aspects of system Timing- System Timing Considerations, some commonly used Storage/Memory elements. (Self study)**Testing and Verification:** Introduction, Logic Verification, Log	10

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

Question paperpattern:

- 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.

Course Code	CO #	Course Outcome (CO)
22EC62	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

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	CO1 Analyze MOSand fabrication transistor theoryprocess.	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 fabricationflow 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

Course Name: Wireless Communication			
Course Code	22EC631	Semester	6
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of to introduce the conceptsof 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 diversity techniques and the recent trends in wireless communication.
- To impart knowledge of important Digital Modulation Techniques, Error Performance in wireless channel and basics of multiple access techniques.

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, ChannelAssignmentStrategies, HandoffStrategies, Interference and SystemCapacity, Trunking and Grade of service, ImprovingCoverage and Capacity in CellularSystems.	10
Module-2	
Mobile RadioPropagation: Large ScalePathLoss: 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 RadioPropagation: Small-ScaleFading 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. Fadingeffects 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	

Digital Modulation Techniques: MPSK & MQAM schemes. **Error Performance in:** AWGN & Fading Channel. **Basics of Multiple Access Techniques:** FDMA,TDMA,CDMA & OFDMA	8

Question paper pattern:

• The question paper will have ten questions.

• Each full question consists of 20 marks.

• There will be 2 full questions (with a maximum of four sub questions) from each module.

• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. 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:

CO #		Course Outcome (CO)
22EC631	**CO1**	Understand and analyze the modern wireless communication systems and cellular concepts
	CO2	Illustrate the effects of atmosphere on radio wave propagation during large scale.
	CO3	Illustrate the effects of atmosphere on radio wave propagation during small scale fading and multi path.
	CO4	Analyze the various equalization and diversity techniques, Understand the recent topics in wireless communication.
	CO5	Understand important Digital Modulation Techniques, Error Performance in wireless channel and basics of multiple access techniques.

CO-PO-PSO Matrix:

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand and 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	Understand important Digital Modulation Techniques, Error Performance in wireless channel and basics of multiple access techniques.	3	3	2									2	3	2	2
		3	2.9	1.9									2	3	2	2

Course Name: Satellite Communication			
Course Code	22EC632	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

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

Modules	Teaching Hours
Modules-1	
Overview of satellite systems: Introduction, Basic concepts of satellite communication, Elements of satellite communication, Frequency allocation and band spectrum, active and passive satellites advantages and disadvantages of satellites, applications. **Orbital aspects of satellite communication :** 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
Modules-2	
Look angle determination: The sub-satellite point, elevation calculation, Azimuth calculation, orbit perturbations. **The Geostationary orbit:** Introduction, polar mount antenna, limits of visibility. near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits.	8
Modules-3	
Space Segment & Earth Segment: **The Space segment:** Introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem. **The Earth segment:** Introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station	8
Modules-4	
Satellite link design and Satellite access: Basic transmission theory, system noise temperature and G/T ratio; noise temperature, calculation of system noise temperature, noise figure and noise temperature G/T ratio for earth stations, Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, uplink and downlink attenuation and C/N, satellite communication link design procedure system design examples.Ku band uplink and downlink design. Rain effects at Ku band.	8
Modules-5	
Propagation Effects and their Impact on Satellite-Earth Links: Introduction**.** Quantifying attenuation and Depolarization, Propagation effect that are not associated with hydrometeors. Atmospheric Absorption, Tropospheric scintillation and low angle fading, Faraday rotation in the atmosphere, 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

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. 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..

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)
22EC632	CO1	Understand the overview of Satellite system, and orbital aspects.
	CO2	Understand the look angles and geostationary orbit.
	CO3	Understand the principle, working and operation of various subsystems of satellite as well as earth station.
	CO4	Analyze and Design satellite communication link
	CO5	Learn the Propagation Effects and their Impact on Satellite-Earth Links

CO-PO-PSO Matrix:

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the overview of Satellite system, and orbital aspects.	1	1								1			2	1	
CO2	Understand the look angles and geostationary orbit.	2	1	2	2		1	1		3	2	2	1	2	1	
CO3	Understand the principle, working and operation of various subsystems of satellite as well as earth station.	1		1				2			1		1	2	1	
CO4	Analyze and Design satellite communication link	1	2	2	2		1	1		2	2	3	1	1	2	1
CO5	Learn 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	1.2	1.2	1.6		1	1.3		2.3	1.6	2.3	1	1.6	1.4	1

Course Name: Optical Fiber Communication			
Course Code	22EC633	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objective:

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

Modules	Teaching Hours
Module-1	
Introductions to fundamental of fiber optics, Different Generations of optical fiber communication systems, Optical fiber structure, Fiber types. Modes in optical fiber signal degradation in optical fibers, fiber losses.	9
Module-2	
Optical sources, Characteristics of optical sources. LED & ILD, Light source materials. Modulation capability. Photo detectors, PIN photodiode and Avalanche photodiodes, Photo detector noise.	9
Module-3	
Optical receiver performance calculations, Power lunching and coupling power coupling calculations, lensing schemes for coupling improvement. Fiber joints, fiber fabrication, cables and connectors, fiber splices, link Analysis and fiber codes.	8
Module-4	
WDM, optical coupler and optical measurements. Coherent optical systems. Methods of modulation, Heterodyne and Homodyne systems, Noise in coherent systems Multichannel coherent systems.	8
Module-5	
Introduction to light wave networks and different topologies.SONET/SDH, SONET/SDH Benefits, SONET and SDH Rates,SONET/SDH Frame.	8

Text Books:

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

Reference Books:

1. Optical fiber Communications. –GERD KEISER, 4thEdition, McGraw Hill internationaleditions.
2. Fiber Optic Communication , Joseph C Palais, Pearson Education, 2005
3. Optical fiber & Fiber Optical Communication Systems – DrSubirKumar
4. Sarkar, S.Chand (G/L) &Company Ltd.
5. https://onlinecourses.nptel.ac.in
6. https://nptel.ac.in/courses/117/104/117104127

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.

Course Code	CO #	Course Outcome (CO)
22EC633	CO1	Understand optical fiber transmission link, fiber modes, structures and fiber losses.
	CO2	Analyze optical sources and detectors
	CO3	Understand receiver noise and coupling.
	CO4	Analyze WDM and multichannel coherent systems.
	CO5	Illustrate optical networks and understand various standards.

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	Understand optical fiber transmission link, fiber modes, structures and fiber losses.	3	2	1									1	3		1
CO2	Analyze optical sources and detectors	3	2	1									1	3		1
CO3	Understand receiver noise and coupling.	3	2	1									1	3	2	1
CO4	Analyze WDM and multichannel coherent systems.	3	2	1									1	3	2	1
CO5	Illustrate optical networks and understand various standards.	3	2	1									1	3	2	1
Average		3	2	1									1	3	2	1

Course Name: Soft Computing			
Course Code	22ECOE641	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of soft computing and the need of it in modern world.
- To impart knowledge of fuzzy logic, various fuzzy systems, and related concepts.
- To impart knowledge of neuro-fuzzy systems, modeling, and data clustering algorithms.
- To impart knowledge of neural networks and their different types.
- To impart knowledge of fuzzy decision-making approaches and engineering applications of soft computing

Modules	Teaching Hours
Module-1	
Evolution of Computing, Soft Computing constituents, From conventional AI to computational intelligence, Machine learning basics, Probabilistic reasoning and Bayesian networks.	8
Modules-2	
Fuzzy Sets, Fuzzy Logic, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Numbers, Linguistic variables, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems.	8
Modules-3	
AdaptiveNeuro- Fuzzy Inference Systems,Coactive Neuro-Fuzzy Modeling, **Advanced Neuro-Fuzzy Modelling**:Classification and Regression Trees, Data Clustering Algorithms.	8
Modules-4	
Adaptive Networks: Introduction, Architecture, Backpropagation for Feedforward networks, Extended backpropagation for Recurrent networks, Hybrid learning rule. **Supervised Learning Neural Networks:** Introduction, Perceptrons, Adaline, Backpropagation Multilayer Perceptrons, RBF Networks, Modular Networks andXOR Problem.	9
Modules-5	
Fuzzy Decision Making: General discussion, Individual decision making, Multiperson decision making, Multicriteria decision making, Multistage decision making, Fuzzy ranking methods. **Engineering Applications:** Introduction, Computer engineering, Reliability theory and Robotics. **Miscellaneous Applications:** Introduction, Fuzzy systems and Genetic algorithms, Fuzzy regression and Interpersonal communication.	9

Text Books:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", A computational approach to learning and machine intelligence, Pearson, 2016.
2. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques",
Addison Wesley, 2003.

3. Neural Networks, S. Haykin, Pearson Education, 2ed, 2001.
4. Soft Computing Techniques in Engineering Applications by Srikanta Patnaik, BaojiangZhong

Reference Books:

1. KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
2. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Pearson 2018.
3. Learning and Soft Computing, V. Kecman, MIT Press, 2001

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)
22ECOE641	CO1	Understand the basics of constituents of Soft Computing
	CO2	Understand and analyze Fuzzy Logic systems
	CO3	Recognize and understand the different Neuro-Fuzzy systems and data clustering algorithms
	CO4	Understand the structure of different neural networks
	CO5	Understand the fuzzy decision-making algorithms and its different applications

CO-PO-PSO Matrix:

		PO												PSO		
CO#	**COs**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	Understand the basics of constituents of Soft Computing	3	3	1							1		2			
CO 2	Understand and analyze Fuzzy Logic systems	3	3	1							1		2			
CO 3	Recognize and understand the different Neuro-Fuzzy systems and data clustering algorithms	3	3	1							1		2	1		2
CO 4	Understand the structure of different neural networks	3	2	2							2		2	2	3	3
CO 5	Understand the fuzzy decision-making algorithms and its different applications	3	3	3		2					2		3	2	3	3
Average		3	3	2.8	1.6		2				1.4		2.2	1.67	3	2.67

Course Name: Automotive Electronics			
Course Code	22EC642	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of architecture of a vehicular system, electronic control unit (ECU), network organization.
- To impart knowledge of networking and classification of bus systems in a vehicle and various bus systems in the vehicle.
- To impart knowledge of different sensors in the vehicle.
- To impart knowledge of different electric and electro-hydraulic actuators in the vehicle.
- To impart knowledge of working of ABS, TCS and ESP in a vehicle.

Modules	Teaching Hours
Module-1	
Architecture: Overview, Vehicle system architecture. **Electronic control unit:** Operating conditions, Design, Data processing, Digital modules in the control unit, Control unit software, Software Development. **Basic principles of networking:** Network topology, Network organization, OSI reference model, Control mechanisms.	**08**
Module-2	
Automotive networking: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, Coupling of networks, Examples of networked vehicles. **Bus systems:** CAN bus, LIN bus, Bluetooth, MOST bus, TTP/C, FlexRay, Diagnosis interfaces	**08**
Module-3	
Automotive sensors: Basics and overview, Automotive applications, Features of vehicle sensors, Sensor classification, Error types and tolerance requirements, Reliability, Main requirements, trends **Sensor types:** Engine-speed sensors, Hall phase sensors, Speed sensors for transmission control, Wheel-speed sensors, Micromechanical pressure sensors, High-pressure sensors, Temperature sensors, Accelerator-pedal sensors, Steering-angle sensors, Position sensors for transmission control, Axle sensors, Piezoelectric acceleration sensors, iBolt™ force sensor, Torque sensor, Rain/light sensor.	**09**
Module-4	
Electric Actuators: Electromechanical actuators, Fluid-mechanical actuators, Electrical machines **Electrohydraulic Actuators:**Application and Function, Requirements, Design and Operating Concept, Actuator Types.	**08**
Module-5	
Antilock Braking System (ABS): System overview, Requirements placed on ABS, Dynamics of a braked wheel, ABS control loop, and Typical control cycles. **Traction Control System (TCS):** Tasks, Function description, Structure of traction control system (TCS), Typical control situations, Traction control system (TCS) for four wheel drive vehicles **Electronic Stability Program (ESP):** Requirements, Tasks and method of operation, Maneuvers, Closed-loop control system and controlled variables.	**09**

Text Books:

1. Automotive Electronics, Konrad Reif Ed, Bosch Professional Automotive Information, Springer Vieweg, 2015
2. Automotive Electrical and Electronics Equipment by Raj Kumar Chauhan

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.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 40% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Course Code	CO #	Course Outcome (CO)
22ECOE642	CO1	Understand the vehicular architecture, electronic control unit and the network organization
	CO2	Recognize the requirement of bus systems and understand the working of various bus systems in a vehicle
	CO3	Classify the different sensors used in an automotive and understand the different types of sensors involved in an automotive.
	CO4	Understand electronic and electro-hydraulic actuators used in an automotive and classify them.
	CO5	Analyze the working of Antilock Braking System, Traction Control System and Electronic Stability Program.

CO-PO-PSO Matrix:

CO #	Statements	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	Understand the vehicular architecture, electronic control unit and the network organization	3	2											3		
CO 2	Recognize the requirement of bus systems and understand the working of various bus systems in a vehicle	3	2											3		
CO 3	Classify the different sensors used in an automotive and understand the different types of sensors involved in an automotive.	3	2	3	3									3	2	2
CO 4	Understand electronic and electro-hydraulic actuators used in an automotive and classify them.	3	2	3	3									3	2	2
CO 5	Analyze the working of Antilock Braking System, Traction Control System and Electronic Stability Program.	3	3	3	3	3							3	3	3	3
Average		**3**	**2.2**	**3**	**3**	**3**							**3**	**3**	**2.3**	**2.3**

Course Name: Computer Architecture and Organization			
Course Code	22ECOE643	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of Basic concepts of Computer architecture and organization.
- To impart knowledge of Design concepts of processor and control unit.
- To impart knowledge of Familiarize the basic CPU organization.
- To impart knowledge of memory types and its organization.
- To impart knowledge of Concepts of parallel computing.

Modules	Teaching Hours
Module-1	
Structure of Computers: Computer types,Functional units,Basic operational concepts,Von-Neumann architecture,Bus structure ,Multiprocessor and Multicomputer, Data representation, Fixed and floating point, Computer Arithmetic: Fixed point arithmetic-Addition,Subtraction, Multiplication and Division, Basic ALU Organization	9
Modules-2	
Basic Computer Organization and Design: Instruction codes, Computer registers, computer instructions and instruction cycle, timing and control cycle, memory reference instructions, input-output and interrupt, Central Processing Unit: stack organization, Instruction formats, Addressing modes, Data transfer and manipulation, CISC and RISC.	9
Modules-3	
Memory Organization: Memory Hierarchy, Semiconductor memories, RAM, ROM types of ROM, Cache memory, performance considerations, Virtual memory, Paging, Secondary storage.	8
Modules-4	
Input Output: I/O interface, Programmed IO, Memory Mapped IO, Interrupt driven IO, DMA, IO Processors.	8
Modules-5	
Parallel Processing**:** Basic concept-types of parallel processors, performance considerations, Pipeline Processors-Basic concepts of pipelining,throughput and speedup, pipeline Hazards	8

Text Books:

1. ComputerOrganization by Car Hamacher,ZvonksVranesic,safea Zaky.5th edition McGH
2. J P Hayes,Computer Architecture and Organization,Mcgraw-Hill,2nd edition.

Reference Books:

1. **William Stallings,** Computer Organization and Architecture,Pearson,7th edition.
2. Computer system Architecture, M Morris Mano 3rd edition, Person/PHI
3. Kai Hwang,Faye a Briggs, Computer Architecture and Parallel Processing,McGH

Course Code	CO #	Course Outcome (CO)
22ECOE643	CO1	Identify various components of computer and their interconnection
	CO2	Identify basic components and design of the functional units of computer.

	CO3	Compare and select various Memory devices as per requirement.
	CO4	Compare various types of IO Mapping techniques.
	CO5	Analyze Parallel Processor and Pipeline Processor

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 various components of computer and their interconnection	3	2		3								2	3	3	2
CO2	Identify basic components and design of the functional units of computer.	3	2		3	3							2	3	2	1
CO3	Compare and select various Memory devices as per requirement.	3	3		2	2							2	3	3	3
CO4	Compare various types of IO Mapping techniques.	3	3	2	2								2	3	2	2
CO5	Analyze Parallel Processor and Pipeline Processor	3	3	3	2	2							2	3	2	3
		3	2.6	2.5	2.4	2.3							2	3	2.4	2.2

Course Name: Robotics			
Course Code	22ECOE644	Semester	6
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives:

- To impart the students knowledge in various robot structures.
- To understand the motion analysis and acquire knowledge on kinematics.
- To provide some knowledge of sensors and robot programming.
- To gain skills to develop robot applications.

Modules	Teaching Hours
Module -1	
Fundamentals of Robotics & Automation: Automation and robotics, history of robotics, robotics market and future prospects, robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications, problems	9
Module -2	
Robot Motion Analysis and Control: Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller, types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems.	8
Module -3	
Sensors in Robotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics, problems. **Machine Vision:** Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems.	8
Module -4	
Robot Programming: Methods of robot programming, lead -through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems	8
Module -5	
Robot Applications: Robot cell layouts, multiple robots and machine interference, considerations in work -cell design, work-cell control, interlocks, error detection and recovery, work -cell controller, robot cycle time analysis, graphic simulation of robotic work-cells, problems. Material Transfer, Machine Loading/Unloading: General considerations in robot material handling, material transfer applications, machine loading and unloading.	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 Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.

2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998Roland Siegwart, Illah R. Nourbakhsh, and DavideScaramuzza, "Introduction to Autonomous Mobile Robots", 2ndEdition, PHI, 2011.

Reference Books:

1. Deb.S.R- Robotics technology and flexible Automation, John Wiley, USA. 1992
2. Klafter R.D., Chimielewski T.A., Negin M Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi. 1994
3. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA. 1991
4. Introduction to Robotis- Syed V. Niku, PHI Pearson, 2003. Robotics, Control, Sensing , Vision and Intelligence, K. S. Fu, R. C. Gonalez, C.S.G. Lee, McGraw Hill, 1987.

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

Course Code	CO #	Course Outcome (CO)
22ECOE644	CO1	Identify basic components of robot system and its functionality
	CO2	Study various control systems and end effectors.
	CO3	Analyze sensors of robot and machine vision system.
	CO4	Describe the robot programming methods.
	CO5	Study robot cell design with robot applications.

CO-PO-PSO Matrix:

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 and end effectors.	1	2	2				2					2	2	2	
CO3	Analyze sensors of robot and machine vision system.	1	2	2				2				2	2	2	2	2
CO4	Describe the robot programming methods.	1	2	2	2			2				2	2	2	2	
CO5	Study robot cell design with robot applications.	1	2	2	2			2				2	2	2	2	
Average		1	2	2	2			2				2	2	2	2	2

Course Name: Project Phase-I			
Course Code	22EC62	Semester	6
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	--
Credits	2	Exam Hours	--
Examination Type (SEE)			

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)
22ECP65	CO1	Implement the layout/schematic as modules
	CO2	Test the individual modules, record the results and analyze
	CO3	Integrate the modules, record the results and analyze
	CO4	Document the work and presentation.
	CO5	Demonstration of the work done (Viva Voce)

Course Name: VLSI Design Lab			
Course Code	22ECL66	Semester	6
Teaching hours per week (L:T:P:S)	0:0:2:0	CIE Marks	50
Total Hours	13 Lab Slots	SEE Marks	50
Credits	1	Exam Hours	03
Examination Type (SEE)	Theory		

Course Objectives:

- To impart knowledge of the schematic & layout of basic gates.
- To impart knowledge of the schematic& layout of combinational circuits.
- To impart knowledge of schematic& layout of Sequential circuits

A. Design and develop schematic, layout and simulate the following
   1. INVERTER
   2. 2/3 Input NAND gate
   3. 2/3 Input NOR gate
   4. Transmission Gate
   5. AND/ OR gate
   6. XOR.XNOR gate7
   7. Y=A+BC

B. Design and develop schematic and layout for following and also simulate and plot the transient response and DC characteristics.
   1. Common Drain amplifier
   2. Common source amplifier
   3. Differential amplifier
   4. Operational amplifier

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 Code	CO #	Course Outcome (CO)
22ECL66	CO1	Develop schematic diagram for logic gates
	CO2	Develop layouts to simulate logic gates
	CO3	Develop layouts to simulate CMOS TG
	CO4	Design analog CMOS circuit for inverting/non inverting amplifier common drain/common source amplifier
	CO5	Simulate analog CMOS circuit for Differential and operational amplifier

PO-PSO Matrix:

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop schematic diagram for logic gates	3	3	3		3								3		
CO2	Develop layouts to simulate logic gates	3	3	3		3								3		
CO3	Develop layouts to simulate CMOS TG	3	2	2		3								2		
CO4	Design analog CMOS circuit for inverting/non inverting amplifier common drain/common source amplifier	3	2	2		3								3	3	2
CO5	Simulate analog CMOS circuit for Differential and operational amplifier	3	2	2		3								3	3	3
		3	2.5	2.5		3								2.8	1.2	1

Course Name: Indian Knowledge Systems			
Course Code	22XXIKS67	Semester	6
Teaching hours per week (L:T:P:S)	2:0:0:0	CIE Marks	50
Total Hours	15 Hours (Theory)	SEE Marks	50
Credits	1	Exam Hours	02
Examination Type (SEE)	Theory		

Course objectives:

- To impart knowledge to facilitate the students with the concept of Indian Traditional Knowledge and to make them Understand the Importance of roots of Knowledge System.
- To impart knowledge to make the students understand the traditional knowledge and analyze it and apply it to their day-to-day-life.

Modules	Teaching Hours
Module -1	
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy Character scope and importance, traditional knowledge vis-à-vis Indigenous knowledge, traditional knowledge V/s. Western knowledge.	5
Module -2	
Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements – Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.	5
Module -3	
Traditional Knowledge in Professional Domain: Town planning and architecture-construction, Health, Wellness and Psychology-Medicine, Agriculture, Governanceand Public Administration, United Nations Sustainable development Goals	5

Text Books:

1. Introduction to Indian Knowledge System - Concept and Applications, B. Mahadevan, VinayakRajat Bhat, NagendraPravana R. N., 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN: 13:978-8126912230
3. Knowledge Traditions and Practice of India: Kapil Kapoor, Avadesh Kumar Singh, Vol1, 2005, DK Print Word (P) Ltd. ISBN:81-246-0334

Suggested Websites:

1. https://www.youtube.com/watch?v=LZPIStpYEPM
2. http://nptel.ac.in/courses/121106003/
3. http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT, Khragpur)
4. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5. https://unctad.org/system/files/official-document/ditcted10_en.pdf

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

Course Code	CO #	Course Outcome (CO)
22ECIKS67	CO1	Provide an overview of the concept of the Indian Knowledge System and its importance.
	CO2	Appreciate the need and importance of protecting traditional knowledge
	CO3	Recognize the relevance of Traditional Knowledge in different domains.

	CO4	Establish the significance of Indian Knowledge Systems in the contemporary world

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%(CIE)**	**50%(SEE)**
QUIZZES		
Quiz-I Quiz-II	Each quiz is evaluated for 05 marks adding upto**10 Marks.**	*****
THEORY COURSE-(Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test–I Test–II	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced To **20 Marks**	*****
EXPERIENTIALLEARNING	**20**	*****
Case Study-based Teaching-Learning	**--**	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	**--**	
Video based seminar(4-5minutes per student)	**--**	
Maximum Marks for the Theory	**---**	**50Marks**
Practical	**--**	**--**
Total Marks for the Course	**50**	**50**

Reference Books	
1	**Introduction to Indian Knowledge System-concepts and applications**, B Mahadevan, VinayakRajatBhat,NagendraPavanaRN,2022,PHILearningPrivateLtd,ISBN-978-93-91818-21-0
2	**Traditional Knowledge System in India**, AmitJha,2009,Atlantic Publishers and Distributors (P)Ltd.,ISBN-13:978-8126912230,
3	**Knowledge Traditions and Practices of India**, Kapil Kapoor, AvadeshKumarSingh,Vol.1, 2005,DKPrintWorld(P)Ltd.,ISBN81-246-0334,

H. K. E. Society's

Poojya Doddappa Appa College of Engineering, Kalaburagi

B.E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations 2022

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

VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No.	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22EC71	Embedded Systems and Applications	TD- E & CE Dept. PSB- E & CE Dept.	3	0	2		03	50	50	100	4
2	IPCC	22EC72	Computer Communication Networks	TD- E & CE Dept. PSB- E & CE Dept.	3	0	2		03	50	50	100	4
3	PCC	22EC73	Information Theory and Coding	TD- E & CE Dept. PSB- E & CE Dept.	4	0	0		03	50	50	100	4
4	PEC	22EC74X	Professional Elective-III	TD- E & CE Dept. PSB- E & CE Dept.	3	0	0		03	50	50	100	3
5	OEC	22ECOE75X	Open Elective-II	TD- E & CE Dept. PSB- E & CE Dept.	3	0	0		03	50	50	100	3
6	PROJ	22ECP76	Major Project Phase-II	TD- E & CE Dept. PSB- E & CE Dept.	0	0	12		03	50	50	100	6
										300	300	600	24

Professional Elective Course-III

22EC741	Radar and Navigational Aids	22EC744	Time-Frequency Analysis
22EC742	Introduction to Machine Learning	22EC745	Digital Image Processing
22EC743	Cryptography and Network Security	22EC746	Error Control Coding

Open Elective Course-II

22ECOE751	Introduction to Mobile Communication	22ECOE754	Digital Marketing
22ECOE752	Engineering Materials and Sensors	22ECOE755	Data Warehousing and Data Mining
22ECOE753	Mechatronics		

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, PEC: Professional Elective Course, OEC: Open Elective Course PR: Project Work, L: Lecture, T: Tutorial, P: Practical S: Self-Study; SDA: Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. TD-Teaching Department, PSB: Paper Setting department, OEC: Open Elective Course, PEC: Professional Elective Course, PROJ: Project work.

Course Name: Embedded Systems and Applications (Industry Suggested)			
Course Code	22EC71	Semester	7
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (10-12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- To understand the basics of computer organization and the architecture of the ARM Cortex-M0 processor.
- To develop embedded C programming skills using the PSoC platform.
- To explore the architecture of the Infineon PSoC 4100S and its interrupt handling mechanisms.
- To Study GPIO and ADC modules supported by PSoC 4100S.
- To provide hands-on experience in interfacing the Infineon PSoC with peripherals such as GPIO, LEDs, LDRs (via ADC), timers, and PWM modules.

Module-1	Teaching Hours
Computer Architecture: Introduction to embedded systems - Types, Evolution of embedded systems, CPU Architecture – Von-Neumann and Harvard architecture, Address space and peripherals, Memory Architecture and its types, Memory hierarchy on microcontrollers, Memory mapping, Interconnects, Infineon PSoC 4100S ARM Cortex M0. **Cortex M0 Architecture:** Understanding different types of processors, Elements of microcontroller.	8 Hours
Module-2	
Introduction to Embedded Software Programming – Basic Concepts, C Programming data types, Software development flow. **Instruction usage examples** – Program control, data access, data programming, data types.	8 Hours
Module-3	
Overview of Infineon PSoC 4100S architecture - Programmer's model, memory mapping, interrupts and exceptions, NVIC, Debug system, Program image and startup sequence. **Interrupts and Exceptions** – Event Driven System, Polling Method of event, Exception, Interrupt and Exception handler, Different types of Exceptions, Operation Modes, Register Bank, Interrupt Controller, Brief overview of NVIC, NVIC Registers, Vector Table, Exception Entry Sequence, Exception Exit Sequence, Interrupt Process(complete)	9 Hours
Module-4	
GPIO – Pins, Pads, Ports; Power supplies; Examples; Basic Pad configuration, PSoC Port architecture, Register Port Management, Examples. **ADC** - Introduction & Basics of Signal, Analog signal to digital signal conversion, Sample and Hold circuit, SAR ADC, SAR ADC Architecture, A/D converter Properties, SAR ADC – Interrupts, SAR ADC – Registers.	8 Hours
Module-5	
Timers, Counters and PWM – Introduction to timers and counters, Timer architecture, Applications of timers and counters. Introduction to TCPWM module, PSoC Register configuration, Clocking system. Interfacing of Infineon PSoC 4100S Board with GPIO, LED, LDR (ADC), Timers and PWM.	9 Hours

Question paper pattern:

- The question paper shall have five modules 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. The Definitive Guide to ARM Cortex M0 and M0+ processors, Joseph Yiu, Second Edition, Newnes.
2. PSoC 4 Architecture Technical Reference Manual (TRM), Infineon Technologies AG.
3. PSoC™ 4100S Plus Datasheet, Infineon Technologies AG..

Industry –Sponsored Lab by-

Infineon Technologies Semiconductor India Private Limited, Bengaluru.

List of Experiments/ Programs

Programming on Embedded C using V S Studio

1. A demo session of the programming with necessary theory concepts focused on Linker scripts and Makefiles
2. Develop programs on linker script fulfilling the following requirements.
   Learn & understand the concept of wildcard notation in programming.
3. Describe the memory regions of microcontroller using memory command.
   Using examples: Arithmetic operations.
4. LED Blinking program (output).
   i. Blinking Multiple LED,
   ii. Toggle
   iii. Delay
5. Reading a switch & controlling an LED (input/output).
6. Develop a program on Timer in PSoC.
7. Develop a program on Counter in PSoC.
8. Configure SYSTICK to generate an interrupt once every 0.5 sec.
9. ADC generation using LDR module on PSoC.
10. Interfacing DC motor with PWM on PSoC

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

Course Code	CO #	Course Outcome (CO)
22EC71	CO1	Explain the fundamentals of computer organization and the ARM Cortex-M0 architecture used in PSoC 4100S
	CO2	Develop and implement embedded C programs for basic operations on the PSoC platform.
	CO3	Analyse the internal architecture, interrupt system, and functional modules of the Infineon PSoC 4100S microcontroller.
	CO4	Demonstrate configuration and usage of GPIO and ADC modules in real-time embedded applications
	CO5	Design and implement embedded system applications by interfacing Infineon PSoC 4100S Board with peripherals like LEDs, LDRs (via ADC), Timers, and PWM.

22EC71: **Embedded Systems and Applications**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Explain the fundamentals of computer organization and the ARM Cortex-M0 architecture used in PSoC 4100S.	3	3	3		2				3			2	3	2	2
CO2	Develop and implement embedded C programs for basic operations on the PSoC platform.	3	3	3		2				3			2	3	2	2
CO3	Analyze the internal architecture, interrupt system, and functional modules of the Infineon PSoC 4100S microcontroller.	3	3	3		2				3			2	3	2	2
CO4	Demonstrate configuration and usage of GPIO and ADC modules in real-time embedded applications.	3	3	3		3				3			2	3	2	2
CO5	Design and implement embedded system applications by interfacing Infineon PSoC 4100S Board with peripherals like LEDs, LDRs (via ADC), Timers, and PWM.	3	3	3		3				3			2	3	2	2
Average		3	3	3		2.8				3			2	3	2	2

Course Name: Computer Communication Networks			
Course Code	22EC72	Semester	7
Teaching hours per week (L:T:P:S)	3:0:2:0	CIE Marks	50
Total Hours	42 Hours (Theory) + (10-12) Lab slots	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- 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.	9 Hours
Module-2	
DATALINK 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 Hours
Module-3	
Wired LANs: Ethernet – IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, and Comparison. **Connecting Devices, Backbone Networks & Virtual LANs.**	8 Hours
Module-4	
NETWORK LAYER: Duties and Responsibilities- Logical Addressing-Classful and Classless Addressing, IPv4protocol, IPv4vsIPv6, Transition from IPv4 to IPv6, Routing- Unicast and Multicast Routing Protocols.	8 Hours
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.	9 Hours

Question paper pattern:

- The question paper shall have five modules 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. Data Communication &Networking ,B.Forouzan,4thEd.,TMH,2006.
2. Computer Communication Networks,Andrew.S.Tanenbaum,4thED.,PHI.

Reference Books:

1. Computer and Communication Networks, NaderMir, Pearso nEducation, 3rd Edition,2009.
2. An Engineering Approach to Computer Networking, Keshav.S, Addison WessleyPublishers.

Integrated Lab Programs

1. Implement the data link layer framing methods such as character, character stuffing and bit stuffing.
2. Program to implement datalink layer farming method checksum.
3. Program to implement Hamming Code generation for error detection and correction.
4. Write a Program to implement on a dataset of characters the three CRC polynomials – CRC 12, CRC 16
5. Program to implement Stop and Wait Protocol.
6. Develop and implement a simple data link layer protocol that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.
7. Program to Implement congestion control using leaky bucket algorithm.
8. Implement Dijkstra 's algorithm to compute the shortest path through a graph.
9. Implement Distance vector routing algorithm by obtaining routing table at each node (Take an example subnet graph with weights indicating delay between nodes).
10. Program to implement Broadcast tree by taking subnet of hosts

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

Course Code	CO #	Course Outcome (CO)
22EC72	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.

22EC72: **Computer Communication Networks**

CO#	CO	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	Apply 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 LANs.	3	1	1									1	2	1	
CO4	Apply the concepts of Network Layer and its protocols and realize them.	2	2	1		1							1	2	1	2
CO5	Apply the concepts of Transport Layer and its protocols, and 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

Course Name: Information Theory and Coding			
Course Code	22EC73	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	4	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Understand the concepts of Entropy, rate of information and order of source with reference to dependent and independent source.
- Study various Encoding Algorithm.
- Model discrete and Continuous Communication Channels.
- Study various error control coding & decoding algorithms

Module-1	Teaching Hours
Information Theory: Introduction, Measure of information, Information content of a message, Average information content(Entropy) of symbols in long independent sequences, Average information content of symbols in long dependent sequences, Markoff statistical model for information sources, Entropy & information rate of Markoff sources.	8 Hours
Module-2	
Source Coding: Encoding of source output, Shannon's encoding algorithm, Shannon Fano encoding algorithm, Source coding theorem, Prefix codes, Kraft-McMillan inequality, Huffman codes.	8 Hours
Module-3	
Information Channels: Communication channel, Discrete communication channel, Channel matrix, Joint probability matrix, Rate of information transmission over a discrete channel, Capacity of discrete memoryless channel, Discrete channels with memory, Mutual information, Continuous channels, Shannon-Hartley theorem & its implications.	9 Hours
Module-4	
Error Control Coding: Introduction, Examples of error control coding, Methods of controlling errors, Types of errors, Linear Block Codes, Matrix description of LBC, Single error correcting Hamming codes, Table Lookup decoding using the standard array, BCH and Reed Muller codes. **Binary Cyclic Codes:** Algebraic structure of Cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation, Error detection & Error correction,	8 Hours
Module-5	
Convolution Codes: Convolution Encoder, Time domain approach & Transform domain approach, Code tree, Trellis, & state diagram, Maximum-Likelihood decoding of convolutional codes, Viterbi algorithm.	9 Hours

Question paper pattern:

- The question paper shall have five modules 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. Digital and Analog Communication Systems byK.Sam Shanmugam
2. Digital Communication bySimon Haykin

Reference Books:

1. Information Theory Coding and Cryptograph byRanjan Bose
2. Error Control Coding and Cryptography by Shu Lin, Daniel J Costello Jr.

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

Course Code	CO #	Course Outcome (CO)
22EC73	CO1	Understand concepts of Dependent & Independent Source, Measure of Information, Entropy, Rate of information and order of a source.
	CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding algorithm.
	CO3	Model the continuous and discrete communication channels using input, output & joint probabilities
	CO4	Determine code words using Linear Block codes, Cyclic codes & Convolution Codes.
	CO5	Design the Encoding and Decoding circuits for Linear Block Codes, Cyclic Codes & Convolutional Codes.

22EC73: **Information Theory and Coding**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand concepts of Dependent & Independent Source, Measure of Information, Entropy, Rate of information and order of a source.	3	2										1	3		
CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding algorithm.	3	2										1	3		
CO3	Model the continuous and discrete communication channels using input, output & joint probabilities	3	3	3		2							1	3	2	2
CO4	Determine code words using Linear Block codes, Cyclic codes & Convolution Codes.	3	3	3		2							1	3	2	2
CO5	Design the Encoding and Decoding circuits for Linear Block Codes, Cyclic Codes & Convolutional Codes.	3	3	3		2							1	3	2	2
Average		3	2.6	3		2							1	3	2	2

Course Name: RADAR &Navigational Aids			
Course Code	22EC741	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Fundamentals of Radar
- Different types of Radar and their working
- Radar signal Detection techniques
- Radar Navigation Techniques

Module-1	Teaching Hours
BASICS OF RADAR: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.	9 Hours
Module-2	
CW AND FREQUENCY MODULATED RADAR: Doppler Effect, CW Radar — Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.	8 Hours
Module-3	
MTI and PULSE DOPPLER RADAR: Introduction to Doppler and MTI Radar, Delay Line Canceller, Moving Target Detector, Pulse Doppler Radar, Noncoherent MTI CW Radar, FM CW Radar. Tracking Radar- Monopulse tracking, conical scan and sequential lobing.	8 Hours
Module-4	
RADAR RECEIVERS: Noise Figure and Noise Temperature, Displays —types. Duplexers — Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas — Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.	8 Hours
Module-5	
NAVIGATIONAL AIDS: Introduction, Four Methods of Navigation ,Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation, Aids to approach and Landing. **SONAR:** Introduction, History of SONAR, Underwater propagation. Electronic counter measures and Electronic counter counter measures: Introduction, ECM,ECCM,ES(Electronic support)	9 Hours

Question paper pattern:

- The question paper shall have five modules 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. MerrillI.Skolnik,"IntroductiontoRadarSystems,"2nd Edition,TMHSpecialIndian Edition, 2007.
2. Byron Edde,"RadarPrincipals,Technology,Applications,"PearsonEducation,1992.

Reference Books:

1. IntroductiontoRadarSystems—MerrillI.Skolnik,3rd Edition, TataMcGraw-Hill,2001.
2. Peebles, "Radar Principles," Wiley, NewYork, 1998.

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

Course Code	CO #	Course Outcome (CO)
22EC741	CO1	Able to understand the Radar operation & targets of the system.
	CO2	Analyse the functional aspects of CW and Frequency modulated Radar.
	CO3	Understand the difference between MTI and Monopulse Radar & apply the concepts in the analysis of tracking system.
	CO4	Understand the basic principles of radar receivers and their schemes.
	CO5	Understand the methods of Navigation approaches.

22EC741: **RADAR & Navigational Aids**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Able to understand the Radar operation & targets of the system.	2	2	1					1				2	2	1	1
CO2	Analyse the functional aspects of CW and Frequency modulated Radar.	2	2	1					1				2	2	1	1
CO3	Understand the difference between MTI and Monopulse Radar & apply the concepts in the analysis of tracking system.	2	2	2	1				1				2	2	1	1
CO4	Understand the basic principles of radar receivers and their schemes.	3	2	1			1		1				2	3	1	2
CO5	Understand the methods of Navigation approaches.	3	3	2					1				2	3	2	2
Average		2.4	2.2	1.4	1		1		1				2	2.6	1.2	1.4

Course Name: Introduction to Machine Learning			
Course Code	22EC742	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- 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

Module-1	Teaching Hours
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.	9 Hours
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 Hours
Module-3	
Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm.	8 Hours
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 neighbour learning, locally weighted regression, radial basis function, cased-based reasoning.	8 Hours
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 Hours

Question paper pattern:

- The question paper shall have five modules 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. 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 Outcomes: On completion of the course, the student will have the ability to,

Course Code	CO #	Course Outcome (CO)
22EC742	CO1	Identify the problems for machine learning Investigate concept learning,
	CO2	Apply supervised learning for the given problem.
	CO3	Analyse the concept of Artificial Neural Networks, Back Propagation algorithm
	CO4	Analyse 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.

22EC742: **Introduction to Machine Learning**

CO#	CO	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	Analyse the concept of Artificial Neural Networks, Back Propagation algorithm	3	3	2		2								3	2	2
CO4	Analyse 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	2.4	2.4		2								3	2	2

Course Name: Cryptography and Network Security			
Course Code	22EC743	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and counter measures.
- To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
- To familiarize Digital Signature Standard and provide solutions for their issues.
- To familiarize with cryptographic techniques for secure (confidential) communication of two parties over an insecure (public) channel; verification of the authenticity of the source of a message.

Module-1	Teaching Hours
Overview: Need for information security, Services, Mechanisms and Attacks, Model for network security, Cryptography, Cryptanalysis. C**lassical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play Fair Cipher, Hill Cipher. **Block Ciphers and the Data Encryption Standard (DES) Algorithm:** Traditional Block and Stream Cipher structures, Feistel Cipher, The Data Encryption Standard (DES) algorithm, Avalanche effect, Strength and Weaknesses of DES.	9 Hours
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.	8 Hours
Module-3	
Message Authentication and Cryptographic Hash Functions: Authentication Requirements and Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. **Digital Signatures and Authentication Protocols:** Digital Signature Schemes and Authentication Protocols, Digital Signature Standard (DSS).	9 Hours
Module-4	
Authentication Applications Entity/Message Authentication, Kerberos, Kerberos versions 4, X.509 authentication service, Kerberos Encryption techniques.	8 Hours
Module-5	
Security in Network based Applications Electronic Mail Security: Pretty Good Privacy (PGP), Data Compression using ZIP. **IP Security:** Overview, IP security architecture, Authentication header, Encapsulating Security Pay Load (ESP). **Firewalls:** Design principles, Trusted systems.	8 Hours

Question paper pattern:

- The question paper shall have five modules 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. Cryptography, Network Security and Cyber Laws–Bernard Menezes, Cengage Learning, 2010 edition

Reference Books:

1. Cryptography and Network Security- Behrouz A Forouzan, DebdeepMukhopadhyay, Mc-GrawHill, 3rd Edition, 2015
2. CryptographyandNetworkSecurity-WilliamStallings,PearsonEducation,7thEdition
3. Cyberlaw simplified-VivekSood,Mc-GrawHill,11threprint,2013
4. Cyber security and Cyber Laws, Alfred Basta, Nadine Basta, Mary brown, Ravindra Kumar, Cengage learning

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

Course Code	CO #	Course Outcome (CO)
22EC743	CO1	Describe and apply the conventional encryption techniques.
	CO2	Implementation of public key cryptographic techniques.
	CO3	Analyze Hash functions and Digital signature schemes.
	CO4	Analyze and evaluate authentication services and applications.
	CO5	Analyze and describe the role of information and network security.

22EC743: **Cryptography and Network Security**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe and apply the conventional encryption techniques.	3	3									3	3	3	3	3
CO2	Implementation of public key cryptographic techniques.	2	2	3		3						3	3	3	3	3
CO3	Analyze Hash functions and Digital signature schemes.	2	2	3		3						3	3	3	3	3
CO4	Analyze and evaluate authentication services and applications.	2	2	3		3						3	3	3	3	3
CO5	Analyze and describe the role of information and network security.	3	3	3								3	3	1	1	
Average		2.4	2.4	3		3						3	3	2.6	2.6	3

Course Name: Time Frequency Analysis			
Course Code	22EC744	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Discuss FT, STFT and signal localization
- Construct Dyadic wavelets and Haar transform
- Understand multi resolution and wavelets
- Understand orthogonal wavelets

Module-1	Teaching Hours
Introduction: Review of Fourier Transform, Parseval's Theorem and need for joint time-frequency Analysis, Concept of non-stationary signals, Short-time Fourier transform (STFT), Uncertainty Principle, Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, Fundamental s of Hilbert Transform.	9 Hours
Module-2	
Bases for Time – Frequency Analysis: Wavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.	9 Hours
Module-3	
Multiresolution Analysis: Haar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of up samplers and down samplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal frame work of Haar 2-band filter bank.	8 Hours
Module-4	
Wavelets: Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets, Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer, Battle-Lamarie.	8 Hours
Module-5	
Bi-Orthogonal Wavelets and Applications: Construction and design. Case study of bi-orthogonal 5/3 tap design and its use in JPEG 2000. Wavelet Packet Trees, Time-frequency localization, compactly supported wavelet packets, case study of Walsh wavelet packet bases generated using Haar conjugate mirror filters till depth level 3. Lifting schemes for generating orthogonal bases of second-generation wavelets.	8 Hours

Question paper pattern:

- The question paper shall have five modules 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. S. Mallat, A Wavelet Tour of Signal Processing, Academic Press, Second Edition, 1999. 2.L. Cohen, "Time-frequency analysis", Prentice Hall,1995.
2. G. Strang and T.Q. Nguyen, Wavelets and Filter Banks, Wellesley-Cambridge Press, Revised Edition, 1998.
3. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.3. P.P.Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall,1993.
4. M. Vetterli and J. Kovacevic, Wavelets and Subband Coding, Prentice Hall,1995

Reference Books:

1.
2.

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

Course Code	CO #	Course Outcome (CO)
22EC744	CO1	Develop spectral domain techniques for the interpretation of stationary signals
	CO2	Apply Wigner ville distribution for the analysis of signals
	CO3	Develop wavelet-based signal analysis techniques for the interpretation of real-world signals
	CO4	Apply Hilbert transform decomposition on real world signals
	CO5	Develop a software code for effective analysis and interpretation of both stationary and non-stationary signals

22EC744: **Time Frequency Analysis**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop spectral domain techniques for the interpretation of stationary signals	2	2	2		2								1	1	1
CO2	Apply Wigner ville distribution for the analysis of signals	2	2	2		2								1	1	1
CO3	Develop wavelet-based signal analysis techniques for the interpretation of real-world signals	3	3	2		2								1	1	1
CO4	Apply Hilbert transform decomposition on real world signals	2	2	2		2								1	1	1
CO5	Develop a software code for effective analysis and interpretation of both stationary and non-stationary signals	3	2	2		2								1	1	1
Average		2.6	2.4	2		2								1	1	1

Course Name: Digital Image Processing			
Course Code	22EC745	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

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

Module-1	Teaching Hours
Digital Image Fundamentals: Introduction, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.	9 Hours
Module-2	
Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform. **Image Enhancement:** Enhancement by point processing, Spatial Operations, Enhancement in the frequency domain.	9 Hours
Module-3	
Image Filtering and Restoration: Image observation models, Inverse and Weiner Filtering, Least squares Filters. **Fundamental Concepts of:** Edge detection, Boundary extraction, Boundary and Region representation.	8 Hours
Module-4	
Image Segmentation: Discontinuity detection, Thresholding, Region Oriented Segmentation.	8 Hours
Module-5	
Colour Image Processing: Colour Fundamentals, Colour Models, Pseudo colour Processing Morphological Image Processing: Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to gray level images.	8 Hours

Question paper pattern:

- The question paper shall have five modules 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. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, etl, TMH, 2nd Edition 2010.

Reference Books:

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

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

Course Code	CO #	Course Outcome (CO)

22EC745	CO1	Understand the formation and representation of images.
	CO2	Apply various transformation techniques for image enhancement.
	CO3	Implementation of image filtering and edge detection.
	CO4	Perform image segmentation using thresholding methods.
	CO5	Understand basics of colour image processing and perform morphological operations.

22EC745: **Digital Image Processing**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the formation and representation of images.	3	2	2		1							1	3	2	1
CO2	Apply various transformation techniques for image enhancement.	2	3	2		1							1	3	2	1
CO3	Implementation of image filtering and edge detection.	2	3	3		1							1	3	2	1
CO4	Perform image segmentation using thresholding methods.	2	3	3		1							1	3	2	1
CO5	Understand basics of colour image processing and perform morphological operations.	3	2	2		1							1	3	2	1
Average		2.4	2.6	2.4		1							1	3	2	1

Course Name: Error Control Coding			
Course Code	22EC746	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Computation using field arithmetic
- Design Linear Block codes and Cyclic codes
- Implement BCH codes
- Design Convolution codes and Turbo codes

Module-1	Teaching Hours
Introduction to Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field and its basic properties, Computation using Galois Field Arithmetic, Vector spaces and Matrices.	8 Hours
Module-2	
Linear Block Codes: Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed Muller codes, The (24, 12) Golay code, Product codes and Interleaved codes	8 Hours
Module-3	
Cyclic Codes: Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes – Encoding using Feedback shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, The(23, 12) Golay code, Shortened cyclic codes.	8 Hours
Module-4	
BCH Codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Non – binary BCH codes: q – ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes, Decoding of Non – Binary BCH and RS codes: The Berlekamp - Massey Algorithm.	9 Hours
Module-5	
Convolutional Codes: Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft – output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding. **Concatenated Codes & Turbo Codes:** Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes Introduction to Turbo codes, LDPC codes.	9 Hours

Question paper pattern:

- The question paper shall have five modules 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" Pearson /PHI 2nd Edition, 2004.

Reference Books:

2. Blahut, R.E. "Theory and Practice of Error Control Codes" Addison Wesley, 1984.
3. F.J.Mac Williams &N.J.A.Slone, "The theory of error correcting codes" North Holland, 1977.
4. Peterson,W.W. & Weldon, E.J. "Error-Correcting Codes" MIT Press, Cambridge, 1972.
5. Das J, Mullick, S.K. &ChaterjeeP.K, "Principles of Digital Communications" Wiley, 1986.
6. Satyanarayana P.S., "Concepts of Information Theory & coding", Dynaram PublicationsDigital Image Processing and Analysis, B. Chanda and D. Dutta Majumdar, PHI, 2003

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

Course Code	CO #	Course Outcome (CO)
22EC746	CO1	Construct Galois field and its computation
	CO2	Design Linear Block Code using Error detection and correction.
	CO3	Apply Cyclic codes for encoding and decoding
	CO4	Apply decoding procedures for non-binary codes.
	CO5	Apply Convolution and Turbo codes

22EC746: **Error Control Coding**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Construct Galois field and its computation	3	2	2			2							2	2	2
CO2	Design Linear Block Code using Error detection and correction.	2	3	3			2							2	3	1
CO3	Apply Cyclic codes for encoding and decoding	3	2	2			2							2	3	1
CO4	Apply decoding procedures for non-binary codes.	2	3	3			2							2	2	2
CO5	Apply Convolution and Turbo codes	3	3	2			3							3	2	1
Average		2.6	2.4	2.4			2.2							2.2	2.4	1.6

Course Name: Introduction to Mobile Communication			
Course Code	22ECOE751	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Discuss wireless networks and their deployment
- Understand hardware and software components required for mobile communication
- Discuss wireless network architecture
- Understand GSM and TDMA technology

Module-1	Teaching Hours
Wireless Telecommunication Systems and Networks: The history and evolution of wireless radio systems. The development of modern telecommunications infrastructure. **Evolution and deployment of cellular Telephone Systems**: Different generations of wireless cellular networks. 1G cellular systems. 2G cellular systems, 2.5G cellular systems, 3G cellular systems, 4G cellular systems and beyond.	9
Module-2	
Common Cellular System Components: Common cellular network components, Hardware and Software views of the cellular network, 3G cellular system components, Cellular component Identification, Call establishment.	8
Module-3	
Wireless Network Architecture and Operation: The Cellular concept, Cell fundamentals, Capacity expansion techniques. Cellular backhowl networks, Mobility management, Radio resources and Power management, wireless network security.	8
Module-4	
GSM and TDMA Technology: GSM system overview, Introduction to GSM and TDMA, GSM network and system architecture, GSM channel concept. **GSM system operations:** GSM Identities, GSM system operations (traffic cases), GSM Infrastructure communications (UM interface). Other TDMA Systems: - North American TDMA	9
Module-5	
CDMA System Overview: Introduction to CDMA,CDMA network and system architecture, CDMA channel concept, CDMA system operations, IS-95B, CDMA 2000 and W- CDMA.	8

Question paper pattern:

- The question paper shall have five modules 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. Introduction to Wireless Telecommunications Systems and Networks by Gary J. Mullett, India edition, Cengage Learning, 2006
2. Wireless Communications, Principles and Practice by Theodore S Rappaport, Second edition, Pearson Publisher,2013.

Reference Books:

1. Jochen Schiller, ―Mobile Communications, PHI, Second Edition, 2003.
2. William.C.Y.Lee,Mobile Cellular Telecommunications-Analog and Digital Systems, Second Edition,Tata Mc Graw Hill Edition ,2006
3. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005.

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

Course Code	CO #	Course Outcome (CO)
22ECOE751	CO1	Acquire qualitative knowledge about the different generations of mobile communication
	CO2	Understand the concept of cellular system components
	CO3	Gain knowledge about the wireless network architecture and operation
	CO4	Understand the concept of GSM and TDMA technology.
	CO5	Understand the various concepts related to CDMA technology.

22ECOE751: **Introduction to Mobile Communication**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire qualitative knowledge about the different generations of mobile communication	2	2	2										2	2	1
CO2	Understand the concept of cellular system components	3	3	2		2								3	3	2
CO3	Gain knowledge about the wireless network architecture and operation	3	3	2		2								3	3	2
CO4	Understand the concept of GSM and TDMA technology.	2	3	2		2								3	3	2
CO5	Understand the various concepts related to CDMA technology.	2	2	2										2	1	1
Average		2.4	2.6	2		2								2.6	2.4	1.6

Course Name: Engineering Materials and Sensors			
Course Code	22ECOE752	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- To provide basic understanding of engineering materials.
- To describe various conductive and dielectric materials.
- To teach the fundamental concepts of insulating and magnetic materials.
- To provide basic understanding of equipment for characterization of materials
- To teach the basics of Voltage and Current sensors

Module-1	Teaching Hours
Introduction to Electrical and Electronics Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronic and Spintronic materials, Ferromagnetic semiconductors, Left handed materials. **Conductors:** Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect.	8
Module-2	
Conductive Materials and Applications: Mechanically processed forms of electrical materials, Types of conducting materials, Low resistivity materials, High resistivity materials, Contact materials, Fusible materials, Filament materials, Carbon as filamentary and brush material, Material for conductors, cables, wires, solder, sheathing and sealing. **Dielectrics:** Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization, Spontaneous polarization, Behaviour of polarization under impulse and frequency switching, Decay and build-up of polarization under ac field, Complex dielectric constant	9
Module-3	
Insulating Materials: Insulating materials and applications – Ceramic, Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. Choice of solid insulating material for different applications, Liquid insulating materials – Requirements, Transformer oil, Bubble theory, Aging of mineral insulating oils. Gaseous insulating Materials – Air, Nitrogen, Vacuum. **Magnetic Materials:** Origin of permanent magnetic dipole, Magnetic terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetism, Ferromagnetism, Antiferromagnetic and the corresponding materials. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss. Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, Commercial grade soft and hard magnetic materials.	9
Module-4	

Introduction to Nano materials for electrical applications: Historical background, Classification of Nanomaterials, Dielectrics and Nano dielectrics, Nano fluids development, Nano tech electrical applications. **Equipment for characterization of materials:** Use of each equipment with example Fourier Transform Infrared Spectroscopy, Scanning Electron Microscopy, Dynamic light scattering, Temperature gravimetric Analysis, X-ray diffraction, Impedance analyser, Dilatometer, Surface roughness tester, Thermal conductivity tester. Contact angle meter	8
Module-5	
Introduction to sensors for Electrical Applications: General properties of sensors, Voltage and Current sensors, Electric field sensors, Temperature sensors- Contact and non-contact type, Position sensor, Speed sensors.	8

Question paper pattern:

- The question paper shall have five modules 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. Advanced Electrical and Electronics Materials; Processes and Applications by K M Gupta and Nishu Gupta, First edition, Wiley Publisher,2015.

Reference Books:

1. Electrical Engineering Materials by A J Dekker, Pearson Publisher,2016
2. Introduction to Sensors for Electrical and Mechanical Engineering by Martin Novak, First edition, CRC Press,2020
3. Handbook of Material Characterization, Springer, 2018
4. An Introduction to Electrical Engineering Materials by C S Indulkur and Thiruvengadam S 6 th revised edition, 2011
5. Emerging Nanotechnology Applications in Electrical Engineering by Ahmed Thabet Mohamed · IGI Global, 2021.

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

Course Code	CO #	Course Outcome (CO)
22ECOE751	CO1	Acquire qualitative knowledge about the Classification of electrical and electronic materials
	CO2	Understand the concept of Conductive Materials and Dielectrics
	CO3	Gain knowledge of Insulating Materials and Magnetic Materials
	CO4	Explain the concept of Nano materials for electrical applications
	CO5	Understand the properties and types of sensors

22ECOE752: **Engineering Materials and Sensors**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Acquire qualitative knowledge about the Classification of electrical and electronic materials	3	2	2		2								2	2	2
CO2	Understand the concept of Conductive Materials and Dielectrics	2	3	2		2								3	2	2
CO3	Gain knowledge of Insulating Materials and Magnetic Materials	2	2	2		2								2	2	2
CO4	Explain the concept of Nano materials for electrical applications	2	3	2		2								2	1	1
CO5	Understand the properties and types of sensors	3	2	2		2								2	2	1
Average		2.4	2.4	2		2								2.2	1.8	1.6

Course Name: Mechatronics			
Course Code	22ECOE753	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- 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.
- Analyse the importance of communication systems

Module-1	Teaching Hours
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 Hours
Module-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 Hours
Module-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 Hours
Module-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 - Analog Input / Output – Selection of PLC	8 Hours
Module-5	
Communication and 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 Hours

Question paper pattern:

- The question paper shall have five modules 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. W.Bolton "Mechatronics", Pearson education.

Reference Books:
1. NitaigourPremch and Mahalik, "Mechatronics-Principle, Concepts and Applications" Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006.

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

Course Code	CO #	Course Outcome (CO)
22ECOE753	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.

22ECOE753: **Mechatronics**

CO#	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	Analyse 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	Analyse 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	1.6	1.6	0.8			2				1.5	2	2	2	1

Course Name: Digital Marketing			
Course Code	22ECOE754	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Introduce traditional and digital marketing concepts.
- Understand various digital tools, structure and delivery systems
- Understand Marketing strategies and challenges.

Module-1	Teaching Hours
Digital Marketing Foundations: Digital Marketing – Meaning – Role of Internet – Emergence of Digital Marketing as a Tool – Aligning Internet with Business Objectives - Differences Digital from Traditional Marketing - Return on Investments on Digital Marketing Vs. Traditional Marketing -Tools Used for Successful Marketing -SWOT Analysis of Business for Digital Marketing – Blogs, Websites, Portal and Their Differences-Visibility, Visitor Engagement, Conversion Process, Retention, Performance Evaluation.	9 Hours
Module-2	
Digital Marketing Tools: Meaning, Importance and Purpose of Social Media Marketing; Types of Social Media Websites. Blogging: Types of Blogs, Blogging Platforms; Social Media Engagement, Target Audience, Social Media Contents, Do's and Don'ts on Social Media; Search Engine Optimization: Meaning, Common SEO Techniques, Understanding Search Engines, Basics of Keyword Search, Google Rankings; Link Building; Steps to Optimize Website; Basics of Email Marketing: Types of Emails, Mailing List, Email Marketing Tools, Email Structure and Delivery And Email Campaign and Measurement, Email Automation.	9 Hours
Module-3	
Content Marketing & Digital Advertising: Basics of Content Marketing: Introduction, Content Marketing Statistics, Types of Content, Types of Blog Posts, Content Creation, Content optimization, Content Management & Distribution, Content Marketing Strategy, Content Creation Tools and Apps, Challenges of Content Marketing.	8 Hours
Module-4	
Web Analytics: Meaning and need of Search Engine Optimization (SEO) - Search Engine and Its Working Pattern, On-Page and Off-Page Optimization, SEO Tactics – SEM Web Analytics: Keyword Selection-Foundations of Analytics – Google Analytics and Google AdWords; Traffic Behaviour, Data Collection for Web Analytics, Universal Analytics, Tracking Code.	8 Hours
Module-5	
Digital Marketing Strategies: Digital Marketing Strategies–Exploring Digital Marketing; Strategies in Digital Marketing – Digital Landscape, Digital Marketing Plan, Digital Marketing Models-User Behaviour and User Experience Design. Legal and Ethical considerations related to Digital MarketingPractices; Recent Case Studies on Digital Marketing.	8 Hours

Question paper pattern:

- The question paper shall have five modules 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. Ahuja, Vandana, Digital Marketing, India, Oxford University Press, 2015.
2. Das, Abhishek, Application of Digital Marketing for Life Success in Business, India, BPB Publications, 2018.
3. Draper, Stuart and Larson, Jeff, Digital Marketing Essentials, United States, Edify, 2017.
4. Kundu, Shakti. Digital Marketing Trends and Prospects: Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques.(English Edition). India, BPB PUBN, 2021.
5. Mathur, Vibha, Arora, Saloni, Digital Marketing N.P., PHILearningPvt.Ltd.,2020.
6. Romi Sainy, and Rajendra Nargundkar. Digital Marketing: Cases from India.N.P., NotionPress, Incorporated, 2018.

Reference Books:

1.

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

Course Code	CO #	Course Outcome (CO)
22ECOE754	CO1	Develop an understanding of digital marketing concepts, strategies, and techniques.
	CO2	Explain practical experience with industry-standard tools and platforms for a case-based scenario.
	CO3	Apply theories and construct a content marketing and selective advertising medium/ channel fundamentals in a case-based scenario.
	CO4	Analyse the SEO techniques for the better visibility/reach/revenue.
	CO5	Explain legal and ethical considerations related to digital marketing practices.

22ECOE754: **Digital Marketing**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop an understanding of digital marketing concepts, strategies, and techniques.	2	3	2	1		2							2	2	1
CO2	Explain practical experience with industry-standard tools and platforms for a case-based scenario.	3	3	2	1		2							2	3	3
CO3	Apply theories and construct a content marketing and selective advertising medium/ channel fundamentals in a case-based scenario.	2	3	2	1		2							3	3	2
CO4	Analyse the SEO techniques for the better visibility/reach/revenue.	2	3	2	2		2							3	3	2
CO5	Explain legal and ethical considerations related to digital marketing practices.	2	2	2	1		2							2	2	2
Average		2.2	2.8	2	1.2		2							2	2.6	2

Data Warehousing and Data Mining			
Course Code	22EC7OE755	Semester	7
Teaching hours per week (L:T:P:S)	3:0:0:0	CIE Marks	50
Total Hours	42 Hours (Theory)	SEE Marks	50
Credits	3	Exam Hours	03
Examination Type (SEE)	Theory		

Course objectives: This course enables the students to-

- Understand the mathematical principles that support data warehousing and OLAP technologies.
- Apply traditional data warehouse models and mining algorithms, and formulate OLAP queries effectively.
- Identify meaningful patterns in real-world datasets through clustering, classification, and association rule mining techniques.
- Acquire the ability to choose suitable algorithms and evaluate them using appropriate tools for real-life problem-solving scenarios

Module-1	Teaching Hours
Data Warehouse:Data Warehouse basic concepts, Data Warehouse Modelling - Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction. Data cube technology: Efficient Methods for Data Cube Computation, Exploration and Discovery in Multidimensional Databases.	8 Hours
Module-2	
Data Mining: Introduction, what is Data Mining, Motivating Challenges, Data Mining Tasks, which technologies are used for data mining, Kinds of pattern that can be mined, Major issues in data mining. Data Objects and Attributes types. Measuring data Similarity and Dissimilarity, Data Pre-processing: An Overview, Data cleaning, data integration, data reduction, data transformation and data Discretization	9 Hours
Module-3	
Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP Growth Algorithm, Evaluation of Association Patterns.	8 Hours
Module-4	
Classification: Basic Concepts, Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Support Vector Machines, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Ensemble Method	9 Hours
Module-5	
Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms.	9 Hours

Question paper pattern:

- The question paper shall have five modules 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. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, “Introduction to Data Mining”, Addison Wesley, First impression,2014.

Reference Books:

1. G. K. Gupta, "Introduction to Data Mining with Case Studies", 3rd Edition, PHI, New Delhi, 2009.
2. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression,2012

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

Course Code	CO #	Course Outcome (CO)
22ECOE755	CO1	Describe the key concepts and structural models used in data warehousing systems.
	CO2	Identify suitable data mining methods by exploring and interpreting given datasets
	CO3	Distinguish the various patterns that can be uncovered through association rule techniques
	CO4	Assess significant patterns in large data collections to support classification and forecasting
	CO5	Develop appropriate solutions using effective data mining techniques for real-world data analysis tasks.

22ECOE755: **Data Warehousing and Data Mining**

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe the key concepts and structural models used in data warehousing systems.	1	3	1									2	2	1	
CO2	Identify suitable data mining methods by exploring and interpreting given datasets	3	3	1	1	2							2	3	3	2
CO3	Distinguish the various patterns that can be uncovered through association rule techniques	3	3	2	1	2							2	3	3	2
CO4	Assess significant patterns in large data collections to support classification and forecasting	2	3	1	1	2							2	3	3	2
CO5	Develop appropriate solutions using effective data mining techniques for real-world data analysis tasks.	1	2	1									2	1	1	
Average		1.8	2.8	1.2	1	2							2	2.4	2.2	2

H. K. E. Society's

Poojya Doddappa Appa College of Engineering, Kalaburagi

B.E. in Electronics and Communication Engineering

Scheme of Teaching and Examinations 2022

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

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No.	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22EC81X	Professional Elective-IV (Online Courses) –NPTEL	TD- Respective Dept. PSB-Respective Dept.	3	0	0	-	03	50	50	100	3
2	IPCC	22ECOE82X	Open Elective-III (Online Courses)	TD- Respective Dept. PSB-Respective Dept.	3	0	0	-	03	50	50	100	3
3	PCC	22ECINT83	Internship(Industry/Research) (14-20weeks)	TD-Respective Dept. PSB-Respective Dept.	0	0	12	-	03	100	-	100	10
										200	100	300	16

Professional Elective Course-III (Online Courses)

22EC811	5G Wireless Standard Design	22EC816	RF I/C Design
22EC812	Analog VLSI Design	22EC817	Systems on Chip Design
22EC813	Semiconductors Devices & Circuits	22EC818	Software Defined Radio
22EC814	Fundamentals of Micro & Nano Fabrications	22EC819	Digital Forensic
22EC815	Low Voltage CMOS Circuit Operators	22EC820	Design and Implementation of Human Computer Interfaces

Open Elective Course-II (Online Courses)

22ECOE821	Advanced R-Programming for Data Analysis Business	22ECOE825	Foundation for Virtual Reality
22ECOE822	Drone Systems & Applications	22ECOE826	AI in Digital & Social Marketing
22ECOE823	Automation in Manufacturing	22ECOE827	Block Chain
22ECOE824	Biomedical Instrumentation		

Professional Elective/Open Elective Course: These are the ONLINE courses suggested by the respective Board of Studies

Online Professional Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses relevant to the program and need to be identified by the department and same is to be informed to the students.

Online Open Elective Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses that enables skill enhancements and job opportunities need to be suggested by the department and same is to be informed to the students