BVVS

Basaveshwar Engineering College, Bagalkote

Department of Electronics and Communication Engineering

Vision, Mission Statements and Values

Vision

To achieve excellence in electronics and communication engineering through quality education and research for developing competent professionals.

Mission

1. Foster a dynamic teaching and learning process.
2. Encourage research through innovation and collaboration.
3. Imbibe moral, ethical values and social responsibilities.

Values

The values of the department are

1. Work is Worship
2. Ethics and Integrity
3. Empathy and Compassion
4. Indian Ethos
5. Mutual Respect

BVVS

Basaveshwar Engineering College, Bagalkote

Department of Electronics and Communication Engineering

SWOC Analysis

S:Strength:

1. Infrastructure
   - (i.) ICT enabled classrooms/seminar hall with good ambience.
   - (ii.) Well equipped laboratories to cater curriculum requirements.
   - (iii.) Department library with good number of titles and volumes.
   - (iv.) Scope for academic extension programmes.
2. Faculty
   - (i.) 75% of faculty with Ph.D.
   - (ii.) Faculty with minimum of 12 years teaching experience.
   - (iii.) Faculty retention ratio is 100 %.
3. Students
   - (i.) Students with academic and competitive bent of mind.
   - (ii.) 75% of the students are placed in reputed industries.
   - (iii.) 10% to 15% of the students are registering for B.E. Honours Degree.
4. Curriculum
   - (i.) Research and industry oriented adaptive curriculum.
   - (ii.) Curriculum with integrated courses.
5. Alumni
   - (i.) Alumni works in reputed organizations across the world.
   - (ii.) Alumni interactions with students and faculty to bridge the gap between campus and corporate.

W:Weakness:

1. IPR competencies are inadequate.
2. Relatively less number of memberships in professional bodies.
3. Limited collaborative activities.
4. Less number of inter-disciplinary courses and projects.
5. Less number of industry supported laboratories/courses.
6. Inadequate number of funded projects.
7. Less scope for co-curricular and cultural activities.

O:Opportunities:

1. Establishment of Distant Learning Center (DLC) using existing resources.
2. Participation in collaborative projects/ research work with allied institutions.
3. Fostering alumni participation in academics and placement activities.
4. Establishment of Skilling Centers for students.
5. Faculty exchange programs with academia and industry.
6. Organizing conferences.
7. Facilitating incubation centers for alumni.
8. Scope for academic extension programmes
9. Training on computer usage/ programming languages for general public.
10. Enhancing consultancy activities.

C:Challenges:

1. To incorporate experiential teaching learning process.
2. Adapting curriculum to future industry needs.
3. Fostering collaboration to enhance research, innovation and entrepreneurship activities.
4. Attracting diversified students.
5. Strategies to strengthen the placement activities for higher packages and core companies.
6. Secure additional research grants and consultancy opportunities.
7. Enhance quality publications and file patents.

Programme Outcomes

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

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

c) **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.

d) **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.

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

f) **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.

g) **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.

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

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

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

k) **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **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.

Programme Specific Outcomes (PSOs)

1. Analyze and design systems for electronics, communication, and signal processing applications.
2. Use domain specific tools for design, analysis, synthesis, and validation of VLSI and embeddedsystems
3. Demonstrate the conceptual knowledge with respect to architecture, design analysis and simulationof computer networking and applications

Programme Educational Objectives (PEOs)

PEO1: Our graduates will be able to lead a successful career by solving complex Engineering Problems of society/industry

PEO2: Enable graduates to excel in academia, industry, entrepreneurship and engage in research and lifelong learning

PEO3: Graduates will be able to work effectively as individuals in multidisciplinary environments with high integrity, ethics, human values and societal responsibilities

PEO4: Graduates will be able to exhibit strong leadership, communication, and teamwork skills to succeed in dynamic professional environments and contribute to the global challenges

ANNEXUR

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

SCHEME OF TEACHING AND EXAMINATION

B.E. (Electronics & Communication Engineering) **w.e.f. 2022-23**

I SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	ASC (IC)	22UMA101C	Mathematics for Electrical Sciences - I	Maths Dept.	3	0	2	0	5	50	50	100	4
2.	ASC (IC)	22UPH105C	Physics for Electrical Sciences	Physics Dept.	3	0	2	0	5	50	50	100	4
3.	ESC	22UEC113C	Basic Electronics	Dept.	3	0	0	0	3	50	50	100	3
4.	ESC-I	22UCS120E	Introduction to C Programming	CSE Dept.	2	0	2	0	4	50	50	100	3
5.	ETC-I	22UEC134B	Introduction to Embedded System	Dept.	3	0	0	0	3	50	50	100	3
6.		22UEC135B	Introduction to Communication Technology										
7.	HSMC	22UHS124C	Communicative English	HSS Dept.	1	0	0	0	1	50	50	100	1
8.	HSMC	22UHS125C	Indian Constitution	HSS Dept.	1	0	0	0	1	50	50	100	1
9.	AEC	22UHS128C	Scientific Foundations of Health	Dept.	1	0	0	0	1	50	50	100	1
				Total	17	0	06	0	23	**400**	**400**	**800**	**20**

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

SCHEME OF TEACHING AND EXAMINATION

B.E. (Electronics & Communication Engineering) **w.e.f. 2022-23**

II SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	ASC (IC)	22UMA201C	Mathematics for Electrical Sciences - II	Maths Dept.	3	0	2	0	5	50	50	100	4
2.	ASC (IC)	22UCH209C	Chemistry for Electrical Sciences	Chemistry Dept.	3	0	2	0	5	50	50	100	4
3.	ESC	22UME223C	CAED	Civil / Mechanical Dept.	2	0	2	0	4	50	50	100	3
4.	ESC-I	22UEC114N/ 214N	Engineering Science Course-I (Introduction to Electronics Engineering)	Respective Dept.	3	0	0	0	3	50	50	100	3
5.	PLC-I	22UCS231B	Introduction to Python Programming	CSE Dept.	2	0	2	0	4	50	50	100	3
6.	HSMC	22UHS224C	Professional Writing Skills in English	HSS Dept.	1	0	0	0	1	50	50	100	1
7.	HSMC	22UHS226C	Sanskritika Kannada	HSS Dept.	1	0	0	0	1	50	50	100	1
8.		22UHS227C	Balake Kannada										
9.	AEC	22UHS229C	Innovation and Design Thinking	Dept.	1	0	0	0	1	50	50	100	1
				Total	14	0	06	0	20	**400**	**400**	**800**	**20**

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

SCHEME OF TEACHING AND EXAMINATION

B.E. (Electronics & Communication Engineering) **w.e.f. 2022-23**

III SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	22UMA301C	Partial Differential Equations and Integral Transforms	Maths Dept.	3	0	0	0	3	50	50	100	3
2	IPCC	22UEC302C	Semiconductor Devices and Circuits	Dept.	3	0	2	3	8	50	50	100	4
3	IPCC	22UEC303C	Digital Electronics and Logic Design	Dept.	3	0	2	3	8	50	50	100	4
4	PCC	22UEC304C	Network Analysis	Dept.	3	0	0	2	5	50	50	100	3
5	IPCC	22UEC305C	Data Structures using “C”	Dept.	3	0	2	3	8	50	50	100	4
6	AEC	22UBT340C	Biology for Engineers	BT Dept.	2	0	0	0	2	50	50	100	2
7	PCC	21UMA300M	Bridge Course Mathematics – I*	Maths Dept.	3*	0	0	0	3*	50*	50*	100*	0
	MC	NS	National Service Scheme (NSS)	NSS CO	0	0	2	0	2	100	-	100	0
		PE	Physical Education (PE)(Sports and Athletics)	PED									
		YO	Yoga	PED									
				Total	17	0	8	11	36	**400**	**300**	**700**	**20**
					20*	0*	8*	11	39*	**450***	**350***	**800***	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	50 hours community service to be documented and produced for the examination 10 Points of Allied Service to be documented and produced for the examination									

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

B.E. (Electronics & Communication **w.e.f. 2022-**

IV SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	22UMA401C	Statistics and Probability Distributions	Maths Dept.	3	0	0	0	3	50	50	100	3
2.	PCC	22UEC402C	Signals and Systems	Dept.	3	2	0	1	5	50	50	100	4
3.	IPCC	22UEC403C	Analog Circuit Design	Dept.	3	0	2	0	5	50	50	100	4
4.	IPCC	22UEC404C	Analog and Digital Communication	Dept.	3	0	2	0	5	50	50	100	4
5.	PCC	22UEC405C	ARM Microcontroller	Dept.	3	0	0	0	5	50	50	100	3
6.	PCC	21UEC406L	ARM Microcontroller laboratory	Dept.	0	0	2	0	2	50	50	100	1
7.	HSSM	22UHS424C	Universal Human Values - II	HSS Dept.	1	0	0	0	1	50	50	100	1
8.	PCC	22UMA400M	Bridge Course Mathematics – II*	Maths Dept.	3*	0	0	0	3*	50*	50*	100*	0
	MC	NS	National Service Scheme (NSS)	NSS CO	0	0	2	0	2	100	-	100	0
		PE	Physical Education (PE)(Sports and Athletics)	PED									
		YO	Yoga	PED									
				Total	16	0	8	11	35	**400**	**300**	**700**	**20**
					19*	0	8*	11	38*	**450***	**350***	**800***	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	50 hours community service to be documented and produced for the examination 10 Points of Allied Service to be documented and produced for the examination									

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

B.E. (Electronics & Communication **w.e.f. 2022-**

V SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22UEC501C	Digital Signal Processing	Dept.	3	0	0	0	3	50	50	100	3
2	PCC	22UEC502C	Control Engineering	Dept.	3	0	0	1	3	50	50	100	3
3	PCC	22UEC503C	Computer Networks	Dept.	3	0	0	0	3	50	50	100	3
4	PCC	22UEC504L	Digital Signal Processing Laboratory	Dept.	0	0	2	0	2	50	50	100	1
4	PEC	22UEC506E	Internet of Things	Dept.	3	0	0	0	3	50	50	100	3
		22UEC507E	Verilog Programming										
		22UEC508E	Mobile Communication										
		22UEC509E	Speech Processing										
5	AEC	22UHS521C	Quantitative Aptitude and Professional Skills	Placement Dept.	2	0	0	0	2	50	50	100	2
6	OEC	22UEC508N	Wireless Networks	Dept.	3	0	0	0	3	50	50	100	3
		22UEC532N	Digital Electronics and Microcontrollers										
7	HSSM	22UBT522C	Environmental Studies	BT Dept.	1	0	0	0	1	50	50	100	1
8	MP	22UEC511P	Mini Project	Dept.	0	0	4	0	4	50	50	100	2
	MC	NS	National Service Scheme (NSS)	NSS CO	0	0	2	0	2	100	-	100	0
		PE	Physical Education (PE)(Sports and Athletics)	PED									
		YO	Yoga	PED									
				Total	18	0	8	7	33	**500**	**400**	**900**	**21**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	50 hours community service to be documented and produced for the examination 10 Points of Allied Service to be documented and produced for the examination									

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

B.E. (Electronics & Communication **w.e.f. 2022-**

VI SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22UEC601C	Information Theory and Coding	Dept.	3	0	2	0	5	50	50	100	4
2	PCC	22UEC602C	Electromagnetic Theory	Dept.	3	0	0	0	3	50	50	100	3
3	PCC	22UEC603C	CMOS Digital VLSI Design	Dept.	3	0	0	0	3	50	50	100	3
5	PCC	22UEC618L	CMOS Digital VLSI Design Laboratory	Dept.	0	0	2	0	2	50	50	100	1
6	PCC	22UEC619L	Computer Network Laboratory	Dept.	0	0	2	0	2	50	50	100	1
5	AEC	22UEC600C	Indian Knowledge System	Dept.	2	0	0	2	4	50	50	100	1
6	PEC	22UEC616E	Micro Eelectro Mechanical Systems	Dept.	3	0	0	0	3	50	50	100	3
		22UEC607E	Computer Organization										
		22UEC615E	Embedded Systems										
		22UEC617E	Digital Verification										
		22UEC614E	Fiber Optics and Networks										
7	OEC	22UEC609N	Sensor Technology	Dept.	3	0	0	0	3	50	50	100	3
		22UEC610N	Image Processing										
8	PR	22UEC608P	Project Work	Dept.	0	0	6	0	6	--	---	--	0
	MC	NS	National Service Scheme (NSS)	NSS CO	0	0	2	0	2	100	-	100	0
		PE	Physical Education (PE)(Sports and Athletics)	PED									
		YO	Yoga	PED									
				Total	19	2	8	10	39	**450**	**350**	**800**	**19**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	50 hours community service to be documented and produced for the examination 10 Points of Allied Service to be documented and produced for the examination									

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

B.E. (Electronics & Communication **w.e.f. 2022-**

VII SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22UEC701C	Microwaves and Antenna	Dept.	3	0	0	2	5	50	50	100	3
2	PEC	22UEC711E	DSP Algorithms and Architecture	Dept.	3	0	0	0	3	50	50	100	3
		22UEC712E	Machine Learning										
		22UEC713E	RTL to GDS2										
		22UEC714E	Multimedia Communication										
3	PEC	22UEC715E	Multi-rate Signal Processing	Dept.	3	0	0	0	3	50	50	100	3
		22UEC716E	Cyber Security										
		22UEC717E	IC Technology										
		22UEC718E	Operating Systems										
4	HSSM	22UEC709N	Human Resource and Management	Dept.	3	0	0	0	3	50	50	100	3
5	PR	22UEC708P	Project Work	Dept.	0	0	6	0	6	50	50	100	12
				Total	12	0	06	2	20	**250**	**250**	**500**	**24**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	50 hours community service to be documented and produced for the examination 10 Points of Allied Service to be documented and produced for the examination									

B. V. V. Sangha

BASAVESHWAR ENGINEERING COLLEGE,

B.E. (Electronics & Communication **w.e.f. 2022-**

VIII SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	AEC	22UECXXXX	MOOCs	Online	0	0	0	0	0	0	0	0	3
2.	OEC	22UECXXXX	MOOCs	Online	0	0	0	0	0	0	0	0	3
3.	INT	22UEC801T	Internship	Industry	0	0	0	0	0	50	50	100	10
				Total	0	0	0	0	0	**50**	**50**	**100**	**16**

Syllabus for B.E. I & II – Semester for academic year 2022 – 2023

(For students admitted to I year in 2022-23)

22UEC113C	Basic Electronics	03-Credits, L:T:P (3:0:0)
Hrs/Week: 03		**CIE Marks:**50
Total Hours: 40		**SEE Marks:**50

UNIT – I	10 Hrs

Semiconductor Diodes: Introduction, PN junction diode, characteristics and parameters, diode approximations, DC load line analysis

Diode Applications: Introduction, half wave rectification, full wave rectification, full wave rectifier power supply: Capacitor filter circuit, voltage multiplier, diode logic gates

Zener Diodes: Junction breakdown, circuit symbol and package, characteristics and parameters, equivalent circuit, Zener diode voltage regulator.

Self-study component: ESAKI diode and its working

UNIT – II	10 Hrs

Bipolar Junction Transistors: Introduction, BJT voltages and currents, common base characteristics, common emitter characteristics, common collector characteristics,

BJT Biasing: Introduction, DC load line and bias point, BJT amplification, voltage divider bias.

Amplifier and Oscillator: Single stage CE-amplifier, RC-phase shift oscillator, LC oscillator

Self -study component: BJT as a switch

UNIT - III	10 Hrs

Operational Amplifiers: Introduction, the operational amplifier, block diagram representation of typical op-amp, schematic symbol, op-amp parameters - gain, input resistance, output resistance, CMRR, slew rate, bandwidth, input offset voltage, input bias current and input offset current, the ideal op-amp, equivalent circuit of op-amp, open loop op-amp configurations, differential amplifier, inverting & non inverting amplifier

Op-Amp Applications: Inverting configuration, non-inverting configuration, differential configuration, voltage follower, integrator, differentiator

Self-study component: Op-Amp as zero crossing detector

UNIT - IV	10 Hrs

Boolean Algebra and Logic Circuits: Binary numbers, number base conversion, octal & hexadecimal numbers, complements, basic definitions, axiomatic definition of Boolean algebra, basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, other logic operations, digital logic gates

Combinational logic: Introduction, design procedure, adders- half adder, full adder

Communications: Introduction to communication, communication system, modulation

Self-study component: Half subtractor and full subtractor

Reference books:

1) Mike Tooley, 'Electronic Circuits, Fundamentals & Applications', 4th Edition, Elsevier, 2015.
2) Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2008 ISBN-978-81-203- 0417-84.
3) D P Kothari, I J Nagrath, 'Basic Electronics', 2nd edition, McGraw Hill Education (India),Private Limited, 2018

Course Outcomes:

A student who successfully completes this course should be able to
CO1: Design the basic circuits to get V-I characteristics of semiconductor devices.
CO2: Design a BJT amplifier to meet the given specifications.
CO3: Identify and analyze the different configurations of operational amplifier.
CO4: Design simple logic circuits using basic gates.
CO5: Design type of modulation necessary for a given communication applications.

Course Outcomes	**Programme Outcomes**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3	2	-	2	2	-	-	-	-	-	-
CO2	3	2	3	-	2	1	-	-	-	-	-	-
CO3	3	2	3	-	3	-	-	-	1	-	-	-
CO4	2	1	1	-	2	1	-	-	1	-	-	**1**
CO5	2	1	1	-	2	1	-	-	1	-	-	**1**

22UEC135B	Introduction to Communication Technology	03-Credits (2:0:2:0)
Hrs/Week: 03		**CIE Marks:**50
Total Hours: 40		**SEE Marks:**50

Course Objectives:

The objectives of the course are to

1. Know the fundamentals of different communication systems.
2. Understand modern communication techniques and their utility in modern cellular communication systems.
3. Know the design principles of cellular communication systems.
4. Understand the different communication standards.

Course Outcomes:

After completion of this course the students are able to

CO1: Analyze different communication systems with respect to operation and utility.
CO2: Choose suitable modulation technique for cellular mobile systems.
CO3: Decide specific channel multiple access techniques for a communication application.
CO4: Choose specific communication standards for a given communication application.

UNIT – I **Introduction to communication systems:** Elements of communication systems, Need for modulation, Electromagnetic spectrum and applications, Terminologies in communication systems **Introduction to wireless .communication systems:** Evolution of mobile radio communication, Beginning of Radio, Wireless mobile communication, Applications of wireless communication, Disadvantages of wireless communication systems, Examples of wireless communication systems, Difference between fixed telephone network and wireless telephone network, Development of wireless communication, Fixed network transmission hierarchy, Comparison of wireless communication systems	**10 Hrs**
UNIT – II **Modern communication systems:** Introduction, First generation (1G), Second generation (2G), Generation (2.5G), Third generation (3G), Evolution from 2G to 3Gt, Fourth generation (4G), Digital cellular parameters, Differences between analog cellular and digital cellular systems, wireless local loop (WLL), wireless local area networks (WLANs), Personal Area Networks (PANs), Bluetooth **Introduction to cellular mobile systems:** Introduction, Spectrum allocation, International telecommunication union (ITU), Wireless communication system, Basic components of cellular systems, Cellular system architecture, GSM: Most popular cellular system, type of channels, Cell concept in wireless communication, shape selection of the cell	**10 Hrs**
UNIT – III **Cellular system design fundamentals:** Introduction, Frequency reuse, Cellular capacity increasing parameters, channel assignment strategies, Hand-off strategies, Hands-off Initiation, Type of hands-off on the basis of decision making process, channel assignment strategies for hands-off, Interference, Tracking, Trunking, Grade of service	**10 Hrs**

UNIT – IV	
Multiple access techniques for wireless communication: Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Advanced TDMA, Multipath interference, Comparison between TDMA & FDMA, Space Division Multiple Access (SDMA), Spread spectrum, types of spread spectrum, Code Division Multiple Access (CDMA) **Radio wave propagation:** Introduction, Doppler shift, parameters of multipath channels, fading, diversity techniques, free space propagation model, Phenomenon of propagation, Propagation models	**10 Hrs**

Reference books:

1)George Kennedy, Bernard Davis, S R M Prasanna, "Electronic Communication Systems", Tata McGraw Hill Education Private Limited, New Delhi, 5th Edition

2).Rajeshwar Dass, "Wireless Communication Systems", I. K. international Publishing House Pvt. Ltd., New Delhi

Course Articulation Matrix

Course Outcomes	Programme Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1: Develop the basic knowledge on communication and their classifications	3	2	3	-	2	2	-	-	-	-	-	-
CO2: Apply the acquired knowledge to analyze differences in Generation techniques based on Modern and cellular mobile systems.	3	3	2	-	2	1	-	-	-	-	-	-
CO3: Develop the competence knowledge to preparing fundamental channels assignment strategies.	3	2	3	-	3	-	1	-	-	-	-	-
CO4: Apply the gained knowledge to evaluating the parameters for the multipath channels in Radio wave propagation.	2	1	1	-	3	1	1	-	-	-	-	-

22UEC134B	Introduction to Embedded System	03-Credits, L:T:P (3:0:0)
Hrs/Week: 03		**CIE Marks:**50
Total Hours: 40		**SEE Marks:**50

Course Objectives:

1. To provide knowledge of embedded systems, applications, purpose and processor architectures.
2. To provide background knowledge of communication interfaces, characteristics and quality attributes of embedded systems.
3. To study general purpose processors software and processor peripherals.
4. To impart knowledge of 8051 Microcontroller, features and its applications.

UNIT - I	10 Hrs
Introduction to embedded systems, Embedded system vs. general computing system, Classifications, Purpose of embedded system, Major application areas. The typical embedded system, Microcontrollers, Microprocessors, RISC, CISC, Harvard and Von-Neumann, Big Endian, Little Endian processors.	
UNIT – II	**10 Hrs**
Memory, Sensors, Actuators, Communication interface: Inter Integrated Interface, Serial Peripheral interface, UART, Parallel interface, RS232 and Bluetooth. Characteristics and quality attributes of embedded systems.	
UNIT - III	**10 Hrs**
General purpose processors software: Introduction, Basic architecture, Operation, Instruction set, program and data memory space, registers, I/O, interrupts, Operating System, ASIP's, Microcontrollers, DSP, Selecting Microprocessor. Standard Single Purpose Processors peripherals: Introduction, Timers, Counters and watch dog timers, UART.	
UNIT - IV	**10 Hrs**
8051 Microcontroller: Introduction, Features of 8051 Microcontroller, Block diagram, ALU, PC, ROM, RAM, Address line, Data line, Special function registers, RAM organization, Stack, Basics of Serial Communication, Interrupts, Timers and counters, Input output ports, simple pseudo code.	

Reference books:

4) Shibu K V, "Introduction to embedded systems", Tata McGraw Hill private limited, 2010.

5) Frank Vahid, Tony Givargis, "Embedded system design: A unified hardware/software introduction", John Wiley and Sons, 2001.

6) Kenneth J Ayala, "The 8051 Microcontroller, Architecture programming and applications", West publishing company, college and school division, 1997.

7) Rajkamal, "Embedded systems: architecture, programming and design", Tata McGraw Hill private limited, second edition.

Course Outcomes:

A student who successfully completes this course should be able to

CO1: Gain comprehensive knowledge about embedded systems, major application area of embedded systems and processor architectures.

CO2: Analyze communication interfaces, characteristics and quality attributes of embedded systems.

CO3: Identify general purpose processors software and processor peripherals necessary for embedded systems.

CO4: Explore 8051 Microcontroller capabilities and able to write pseudo codes.

Course Outcomes	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	1	1	-	1	1	1	1	1	1	-	1
CO2	3	2	2	-	1	1	1	1	1	2	-	1
CO3	3	2	2	-	1	2	1	1	2	1	-	2
CO4	3	2	2	-	1	2	1	1	2	1	-	2

22UEC114N/22UEC214N	Introduction to Electronics Engineering	03-Credits, L:T:P (3:0:0)
Hrs/Week: 03		**CIE Marks:**50
Total Hours: 40		**SEE Marks:**50

Course Objectives:

1) Understand the operation of semiconductor devices and their applications.
2) Know transistor (BJT) as an amplifier.
3) Study Op-Amps and its applications.
4) Know logic circuits and their optimization.
5) Understand the principles of transducers and communication systems.

UNIT - I	10 Hrs
Power Supplies –Block diagram, PN Junction Diode Characteristics, Half-wave rectifier, Full-wave rectifiers and filters, Voltage regulators, Output resistance and voltage regulation, Voltage multipliers. **BJT Characteristics and Biasing**- Common Base and Common Emitter Configurations, Voltage Divider Biasing. **Self study component:** Switched Mode Power Supply.	
UNIT – II	**10 Hrs**
Amplifier and Oscillators – Single Stage CE Amplifier, Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, Ladder network oscillator, Wein bridge oscillator, Multivibrators, Single-stage astable oscillator, Crystal controlled oscillators (Only Concepts, working, and waveforms. No mathematical derivations) **Operational amplifiers** - Ideal op-amp; characteristics of ideal and practical op-amp; Practical op- amp circuits: Inverting and non-inverting amplifiers, voltage follower, summer, integrator, differentiator.(Text 1) **Self study component:** Op-Amp as zero crossing detector	
UNIT - III	**10 Hrs**
Boolean Algebra and Logic Circuits: Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates **Combinational logic**: Introduction, Design procedure, Adders- Half adder, Full adder, Parallel Adder **Self study component:** Half subtractor and full subtractor	
UNIT - IV	**10 Hrs**
Analog Communication Schemes – Modern communication system scheme, Information source, and input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Multiplexing, Types of communication systems. Types of modulation (only concepts) – AM , FM. **Digital Modulation Schemes**: Advantages of digital communication over analog communication, ASK, FSK, PSK, Radio signal transmission Multiple access techniques. **Sensors and Interfacing** – Instrumentation and control systems, Transducers, Sensors. **Self study component:** Opto-couplers	

Reference books:

1) Mike Tooley, 'Electronic Circuits, Fundamentals & Applications', 4th Edition, Elsevier, 2015.

2) Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2008 ISBN-978-81-203- 0417-84.

3) D P Kothari, I J Nagrath, 'Basic Electronics', 2nd edition, McGraw Hill Education (India),Private Limited, 2018

Course Outcomes:

A student who successfully completes this course should be able to

CO1: Differentiate semiconductor devices and their parameters based on V-I characteristics.
CO2: Analyze the applications of electronic devices and circuits.
CO3: Analyze logic circuits built with basic gates.
CO4: Solve numerical problems related to basic electronic circuits and systems.
CO5: Decide type of transducer, sensor and modulation for a given application.

Course Outcomes	**Programme Outcomes**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3	2	-	2	2	-	-	-	-	-	-
CO2	3	2	3	-	2	1	-	-	-	-	-	-
CO3	3	2	3	-	3	-	-	-	1	-	-	-
CO4	2	1	1	-	2	1	-	-	1	-	-	**1**
CO5	2	1	1	-	2	1	-	-	1	-	-	**1**

Syllabus for B.E. III & IV – Semester for academic year 2023 – 2024

(For students admitted to I year in 2022-23)

III Semester Syllabus

22UMA301C	Partial Differential Equations and Integral Transforms	Credits :03
L:T:P – 3-0-0		CIE Marks : 50
Total Hours/Week: 03		SEE Marks : 50

UNIT – I Partial Differential Equations I	10 Hrs.
Introduction to PDE, Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. **(RBT Levels: L1, L2 and L3)**	
UNIT – II Partial Differential Equations II	**10 Hrs.**
Solutions of PDE by the method of separation of variable. Derivation of one-dimensional heat and wave equations and their solutions by explicit method, solution of Laplace equation by using five point formulas. **(RBT Levels: L1, L2 and L3)**	
UNIT – III Fourier series	**10 Hrs.**
Periodic functions, Conditions for Fourier series expansions, Fourier series expansion of continuous and functions having finite number of discontinuities, even and odd functions. Half- range series, practical harmonic analysis. **(RBT Levels: L1, L2 and L3)**	
UNIT – IV Fourier transforms and z-transforms	**10 Hrs.**
Infinite Fourier transforms and inverse Fourier transforms- simple properties, Fourier sine and Fourier cosine transforms, Inverse Fourier sine and cosine transforms. Z-transforms-definition, standard forms, linearity property, damping rule, shifting rule-problems. Inverse Z-transforms. **(RBT Levels: L1, L2 and L3)**	

References:

1. Numerical Methods for Engineers by Steven C Chapra &Raymond P Canale.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics By H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. Advanced Engineering Mathematics by E Kreyszig ,John Wiley & Sons.

Course Objectives:

1. PDE‟s provides a powerful tool for quantifying rates of change optimizing functions, and modeling complex systems.
2. To provide a way, to represent periodic functions in terms of simple trigonometric functions.
3. To transform a function from the time domain to the frequency domain.
4. Provides a powerful mathematical tool for analyzing, designing, and manipulating discrete time signals and systems.

Course Outcomes:

After completion of the course the students shall be able to,

1. Identify different types of PDEs including linear vs nonlinear, first order vs higher-order, and partial derivatives of different variables.
2. Learn various analytical techniques to solve to specific types of PDEs, such as variable separable and explicit method.
3. Grasp the concept of representing periodic functions as an infinite sum sinusoidal (sine and cosine) with different frequencies.
4. Grasp the concept of the Fourier transform as a mathematical tool that converts a function from the time domain into the frequency domain.

SUBJECT CODE: 22UEC302C	Semiconductor Devices and Circuits	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Field Effect Transistors:
Introduction, construction, operation and characteristics of JFETs, transfer characteristics. Introduction to MOSFETs, depletion type MOSFET, enhancement type MOSFET, MOS capacitor.
Thyristors: Introduction, construction, operation and characteristics of SCR, TRIAC, UJT.
Applications of Diode: clippers and clampers

UNIT–II	10 Hrs.

FET Biasing:
Introduction, Fixed bias configuration, Self bias configuration, Voltage divider biasing, Common gate configuration, Design, p-channel FETs, Universal JFET bias curve.

UNIT–III	10 Hrs

FET amplifiers:
Introduction, JFET small signal model, voltage divider bias configuration, frequency response of amplifiers.
Power Supplies (Voltage Regulators)**:** Introduction, general filter considerations, capacitor filter, RC filter, discrete transistor voltage regulation, IC voltage regulators.

UNIT–IV	10 Hrs

Optoelectronic Devices: Light units, Light emitting diode (LED), liquid crystal displays (LCD), photo conductive cell, photo diode, solar cells, photo transistors, and optocouplers
Miscellaneous Devices: Schottky diode, varactor diode, power diode, tunnel diode.

PRACTICAL COMPONENT OF IPCC

Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. (preferably open sources):

1. Hardware implementation using discrete components for the following experiments.
2. Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Proteus, Simulink, eSim, Psim)

Reference Books *

1. Nashelesky & Boylestead, “Electronic Devices & Circuit Theory”, 10th Edition, Pearson, 2009.
2. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Theory and Applications, 2013, Fifth edition, Reprint, Oxford University press, New York, USA.
3. D.A. Bell, “Electronic Devices & Circuit”, 4th Edition, PHI, 2007.

Web links and Video Lectures (e-Resources):

1. **https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English**
2. **https://www.google.com/search?q=NPTEL+videos+on+optoelectronics+electronics&rlz=1C1CHMY_enIN992IN992&oq=NPTEL+videos+on+optoelectronics+electronics&aqs=chrome..69i57j33i160.1193773779j0j15&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:a2be5200,vid:WWjldCmRteg**

Course Outcomes**

After completion of the course student will be able to

1. Design clipper, clamper and differentiate different types of electronic devices.

2. Design of MOSFET amplifier for the given specifications using the knowledge of Field Effect Transistor.
3. Design regulated power supply to meet the given specifications and Choose a specific FET and other components to design an amplifier
4. Differentiate the characteristics and their importance of different optoelectronic and other two terminal devices for various applications.

Sl. No.	Experiments
1	**Design a circuit to measure cut in and reverse breakdown voltage of a diode.**
2	**Analysis of a diode halfwave and fullwave rectifier with and without capacitor filter.**
3	**Design a circuit to measure cut in and reverse breakdown voltage of Zener diode.**
4	**Design a voltage regulator using Zener diode and its regulation analysis.**
5	**Construct a circuit to measure and plot the input and output characteristics of a transistor for calculating h-parameters under CB/CC /CE configuration.**
6	**Construct a circuit to perform clipping of positive half cycle/negative half cycle.**
7	**Construct a circuit to perform controlled level shifting of positive half cycle/negative half cycle.**
8	**Design and implement a circuit to amplify the low level signal using BJT/FET under CE/CS configuration and analyse the frequency response.**
9	**Design a circuit to plot the drain and transfer characteristics of JFET and hence find transconductance.**
10	**Design and implement RC phase shift/Colpitt's/Hartley oscillator for the given specifications.**
11	**Voltage versus current characteristics and its analysis of silicon controlled rectifier (SCR).**
12	**Design and implementation of controlled rectifier.**
13	**V-I characteristics and analysis of UJT.**
14	**Design and implementation of UJT as a relaxation oscillator.**
15	**Design 5V/12V regulated power supply.**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	1	1	0	1	1	1	1	1	3	0	0
CO2	3	3	2	2	1	1	0	1	1	1	1	1	3	0	0
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	0	0
CO4	3	3	3	2	1	1	1	1	1	1	1	1	3	0	0

SUBJECT CODE: 22UEC303C	Digital Electronics and Logic Design	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Logic Design Fundamentals:Basic definitions, Axiomatic definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Don't-Care Conditions, NAND and NOR Implementation, Generation of Switching Equations from Truth Tables.Gate-Level Minimization: Introduction, The K-Map Method (up to 4 variable), Quine McCluskey Technique.	
UNIT–II	**10 Hrs**
Design of Combinational Logic Circuits: Introduction to Combinational Circuits, Design Procedure,Half Adder, Full Adder, Half Subtractor, Full Subtractor, N-bit Parallel Adder/Subtractor, Carry Look Ahead Adder, BoothMultiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-multiplexer.	
UNIT–III	**10 Hrs**
Sequential Logic Circuits: The Basic Bistable Element, Latches, Flip-Flops-SR, D, JK & T, Master-Slave SR and JK Flip-Flop, Positive and Negative Edge Triggered D Flip-Flop, Timing Considerations, Characteristic Equations. Registers (SISO, SIPO, PISO and PIPO) and Bidirectional Shift Register, Counter based Shift Registers.	
UNIT–IV	**10 Hrs**
Counters: Binary Ripple Counters, Synchronous Binary Counters, Design of Synchronous and Asynchronous Counter using clocked JK, D, T and SR Flip-Flops. Finite State Machine (FSM):Mealy FSM and Moore FSM, Design Example: Sequence Detection.	
PRACTICAL COMPONENT OF IPCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. 1. Quartus II 2. Logic Circuit Simulator Pro. 3. Proteus Simulator. 4. Digital IC Trainer Kit.	
Reference Books *	
1. Donald D.Givone, "Digital Principle and Design", Tata McGraw Hill Edition, 2002 2. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to theVerilog HDL and System Verilog", 6th Edition, Pearson Private Limited, 2016. 3. John M. Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001Author/s last Name, initial (Year), Book Title (edition), Publisher **Web links and Video Lectures (e-Resources):** 1. https://nptel.ac.in/courses/117106011 2. https://a.impartus.com/ilc/#/course/591142/1030	
Course Outcomes**	
After completion of the course student will be able to 1. Optimize the logic functions using Boolean principles and various mapping techniques. 2. Design and implement different combinational logic circuits. **3.** Analyze and apply the design aspects of sequential logic circuits. **4.** Analyze the design aspects of counters and finite state machine**.**	

Sl. No.	Hardware Experiments
1	Simplification, realization of Boolean expression(s) using basic logic gates and universal gates.
2	Design and implementation of adders, subtractors using basic gates.
3	Design and implementation of parallel adder/subtractor using IC 7483.
4	Realization of decoder chip to drive LED display.
5	Design and implementation of code converters (any two).
6	Implementation of three variable Boolean expression(s) using 4:1MUX and 8:1MUX.
7	Design and implement i. 1-bit and 2-bit comparator using basic gates ii. 4-bit and 8-bit using IC 7485.
8	Design and implement i. Master Slave JK flip-flop using only NAND gates ii. JK flip flop using7476.
9	Design UP and DOWN counter using IC 74193.
10	Design of shift registers using 7 495 viz. SIPO, SISO, PISO, PIPO shift right, shift left.
Software Experiments	
1	Serial adder
2	Memory unit
3	Parallel adder and accumulator
4	Binary multiplier
5	Lamp handball

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	1	2	1	1	1	2	1	-	1	3	1	-
CO2	3	3	3	2	1	1	1	1	2	1	-	1	3	1	-
CO3	3	3	3	2	1	1	1	1	2	1	-	1	3	1	-
CO4	3	2	3	3	2	1	1	1	2	1	-	1	3	1	-

SUBJECT CODE: 22UEC304C	NETWORK ANALYSIS	Credits: 03
L:T:P:S –3:0:0:2		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Introduction to network analysis: Reference directions for current and voltage, Independent and dependent sources, Source transformation, Mesh and Nodal analysis with dependent and independent sources for AC, DC and bridge networks, Star-delta and Delta-star conversions	
UNIT–II	**10 Hrs**
Network theorems: Superposition theorem, Millman's theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem **Network graphs:** Definition of terms. Matrices associated with graphs: incidence, reduced incidence, fundamental cut-set and fundamental tie-set, analysis of networks	
UNIT–III	**10 Hrs**
Transients analysis: (i) RC transients: Storage cycle, Initial values, Instantaneous values, Application; (ii) RL transients: Storage cycle, Initial values, Instantaneous values, Application **Laplace transformation:** Basic theorems, Laplace transform of periodic functions, application of Laplace transform to RL and RC circuits.	
Unit - 4	**10 Hrs.**
Two-Port Network: Two port network analysis using Impedance (Z) parameters, Admittance (Y) parameters, Hybrid (h) parameters and transmission parameters. Relationship between parameters. **Principles of Attenuators and equalizers:** Design of Symmetrical T-type, π-type, Lattice and Bridged-T attenuator, Asymmetrical T, L, and PI attenuators. Design of two terminal series and shunt equalizers	
PRACTICAL COMPONENT OF PCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. : Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Psim, Pspice, Proteus, Simulink, eSim)	
Reference Books *	

Reference Books

1. Robert L. Boylestad, "Introductory Circuit Analysis"(13th edition), Prentice Hall, 2015
2. Roy Choudhary, "Networks and systems", 2nd Edition, New Age International Publications, 2006
3. Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis", 9th Edition, TMH, 2006.
4. G. K. Mithal, "Network Analysis", Khanna Publishers, 1997

Web links and Video Lectures (e-Resources):

1. **https://nptel.ac.in/courses/108105159**
2. **https://nptel.ac.in/courses/108102042**
3. **https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English**
4. **https://psim.software.informer.com/11.1/**
5. **www.ni.com/multisim**

Course Outcomes**

After completion of the course student will be able to

1. Apply various circuit analysis techniques such as mesh analysis, nodal analysis, and source transformation to investigate AC and DC networks
2. Solve voltage and currents in the networks using network theorems and topology

3. Analyze the transient behavior of elements using Laplace transformation
4. Evaluate two-port network parameters and to design attenuators and equalizers

Sl. No.	Experiments
1	Determination of current through each branch of a given network using mesh analysis
2	Determination of current through each branch of a given network using nodal analysis
3	Simplification of given network using star-delta conversion and finding the current in load
4	Simplification of given network using source conversion and finding the current in load
5	Verification of Superposition theorem
6	Verification of Thevenin's theorem
7	Verification of Norton's theorem
8	Verification of Maximum power transfer theorem
9	Verification of Millman's theorem
10	To plot frequency response of RL and RC network
11	To design and verify symmetrical attenuators
12	To design and verify Asymmetrical attenuators

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO2	**3**	**3**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO3	**3**	**3**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CO4	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**

SUBJECT CODE: 22UEC305C	Data Structures using "C"	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
Introduction: Data structures, classifications (primitive & non primitive), data structure operations, pointers and dynamic memory allocation, pointers to arrays, structures, self-referential structures, pointers to structures. Functions: Functions (Passing structure variable as an argument, passing whole structure asargument, passing structure variable as a pointer argument, etc).	
UNIT–II	**10 Hrs**
Dynamically allocated arrays **(**Using calloc() or malloc()**)**, array Operations: traversing, inserting, deleting, searching, and sorting. Stacks: definition, stack operations (push, pop and display. Test: underflow and overflow conditions), array representation of stacks, stacks using dynamic arrays, Stack Applications: infix to postfix conversion, evaluation of postfix expression, program to evaluate postfix expression, program to convert Infix to Postfix expression.	
UNIT–III	**10 Hrs**
Recursion - Factorial, GCD, Fibonacci sequence, tower of Hanoi. Queues: Definition, array representation, queue operations (Insert, delete and display), Circular Queues operations (Insert, delete and display), De-queues (Insert, delete and display), Priority Queues(Insert, delete and display). Programming examples.	
UNIT–IV	**10 Hrs.**
Linked Lists: Definition, representation of linked lists in memory, Linked list operations: Traversing, searching, insertion, and deletion. Doubly linked lists (Traversing, searching, insertion, and deletion), Circular linked lists (Traversing, searching, insertion, and deletion). Implementation of stack and queue using singly linked list. Programming Examples.	
PRACTICAL COMPONENT OF IPCC	
Suggested: Simulation/Modeling/Design/Verification/Hardwar Boards/etc.(preferably open sources) 1. GCC C Compiler 2. Turbo C Compiler	
Reference Books *	

1. Ellis Horowitz and Sartaj Sahni,"" Fundamentals of Data Structures in C"", Universities Press, 2nd Edition, 2014.
2. Gilberg & Forouzan,"" A Pseudo-code approach with C"", Cengage Learning, 2nd Edition,2014
3. Seymour Lipschutz, Schaum's Outlines, „" Data Structures"", McGraw Hill, Revised 1st Edition, 2014.
4. Behrouz A. Forouzan and Richard F. Gilberg, „" Computer Science A Structured Programming Approach Using C"", Thomson, 2ndEdition.
5. A M Tenenbaum, „" Data Structures using C"", PHI,1989.
6. Robert Kruse, „" Data Structures and Program Design in C"", PHI, 2nd edition, 1996.

Web links and Video Lectures (e-Resources):

1. Data Structures and Algorithm Jenny's Lectures CSIT https://www.youtube.com/playlist?list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLl8LU
2. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/

Course Outcomes**

After completion of the course student will be able to

1. Demonstrate the concepts of various types of data structures, operations and algorithms,
2. Write the C programs to demonstrate the concepts different data types.
3. Analyze the performance of Stack, Queue, Lists and Searching and Sorting techniques.
4. Write the C programs for all the applications of data structures.
5. To solve real world problems by applying data structure concepts.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
** **Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	0	0	0	2	1	0	0	0	0	1	2	0	2
CO2	3	2	0	0	0	1	1	0	0	0	0	2	2	0	2
CO3	3	3	0	0	0	1	1	0	0	0	0	3	2	0	2
CO4	3	2	0	0	0	1	2	0	0	0	0	3	2	0	2

22UBT340C/22UBT440C	BIOLOGY FOR ENGINEERS/ BIOINSPIRATION FOR ENGINEERS	02 - Credits (2: 0 : 0)
Hours / Week : 02		CIE Marks : 50
Total Hours : 26		SEE Marks : 50

UNIT-I	06 Hrs.

NATURE BIOINSPIRED MATERIALS AND MECHANISMS

Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature. Human Blood substitutes-hemoglobin based oxygen carriers (HBOCs) and perflourocarbons (PFCs). Artificial Intelligence for disease diagnosis. Bioichips & their applications.

Biosensors & their applications, Nanobiomolecules in medical science, Biofilms in dental treatment.

UNIT–II	06 Hrs.

Bio inspiration models used in engineering: Bio Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs), Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.

UNIT–III	07 Hrs.

HUMAN ORGAN SYSTEMS AND BIO DESIGNS

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson‟s disease).

Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

Lungs as purification system gas exchange mechanisms, spirometry, Ventilators, Heart-lung machine).

Eye as a Camera system, bionic eye. **Kidney** as a filtration system - dialysis systems. **Muscular and Skeletal Systems** as scaffolds, bioengineering solutions for muscular dystrophy and osteoporosis.

UNIT–IV	07 Hrs.

TRENDS IN BIOENGINEERING

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 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). Bio-bleaching.

Reference Books

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.
2. 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
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2020.
6. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, CRC Press, 2012
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
9. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Web links and Video Lectures (e-Resources)

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- 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.

Course Outcomes

After completion of the course student will be able to

1. Corroborate the concepts of biomimetics for specific requirements.
2. Elucidate the basic biological concepts via relevant industrial applications and case studies.
3. Evaluate the principles of design and development, for exploring novel bioengineering projects.
4. Think critically towards exploring innovative bio based solutions for eco friendly and socially relevant problems.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3		2	1		3						1			
CO 2	3	2	1	1		3						1			
CO 3	3		3	1		3						1			
CO 4	3		1	2		3	3					1			

Why Biology for Engineers -

For engineers, understanding the principles of biology is important because it:

Aim - Biology for Engineers allows adaptation of the sciences by looking at ideas, theories and practices that already exist in nature. Biological engineers aim to mimic existing biological systems or modify them to replace, enhance or otherwise improve upon current engineering problems.

Taught from an engineering perspective

- Nature as the engineer
- Evolution as the design tool
- Engineering analogies

1. Provide students with an opportunity to collaborate in the learning process and develop critical thinking skills.
2. Enables the design of biocompatible materials and devices.
3. Helps in developing new medical technologies.
4. Facilitates the creation of sustainable energy systems.
5. Supports the development of bioremediation techniques for environmental cleanup.
6. Informs the development of advanced bio manufacturing processes.
7. Supports the advancement of personalized medicine.

22UMA300M	Bridge Course Mathematics-I	Mandatory - Credits (3 : 0 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

Differential Equations-1	10 Hrs.
Introduction to Differential Equations: Ordinary differential equations of first order**:** Variable separable, Homogeneous. Exact form and reducible to exact differential equations- Integrating factors on $1/N\ (\partial M/\partial y - \partial N/\ )\ and\ 1/M\ (\partial N/\partial x - \partial M/\partial y\ )$. Linear and Bernoulli‟s equation. **(RBT Levels: L1, L2 and L3)**	
Differential Equations-2	**10 Hrs.**
Introduction to Higher Order Differential Equations: Second and higher order linear ODE‟s with constant coefficients-Inverse differential operator, method of variation of parameters (second order); Cauchy‟s and Legendre homogeneous equations. **(RBT Levels: L1, L2 and L3)**	
Partial differentiation	**10 Hrs.**
Introduction to function of several variables: Partial derivatives; Euler‟s theorem - problems. Total derivatives-differentiation of composite functions. Jacobeans-problems. **(RBT Levels: L1, L2 and L3)**	
Integral Calculus and Beta, Gamma functions	**10 Hrs.**
Introduction to Multiple integrals: Evaluation of double and triple integrals. Area bounded by the curve. **Introduction to Beta and Gamma functions:** Definitions, Relation between beta and gamma functions-problems. **(RBT Levels: L1, L2 and L3)**	
References: 1. Maurice D weir, Joel Hass and Frank R. Giordano, “Thomas calculus”, Pearson, eleventh edition, 2011. 2. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017. 3. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010. 4. Erwin Kreyszing‟s Advanced Engineering Mathematics volume1 and volume1I,wiley India Pvt.Ltd.,2014.	

Course Objectives:

This course will enable students

1. Used (ODE‟S) to describe and model various phenomenons in Physics, Engineering, Biology, Economics and other scientific disciplines.
2. To formulate mathematical equations that capture the behavior and relationships of the variables involved.
3. Can better understand the behavior of multivariable functions, solve optimization problems, analyze physical systems, and develop advanced mathematical techniques for various applications.
4. Gain tools and techniques necessary to analyze accumulated quantities, calculate areas and volumes optimize functions, model physical systems.
5. To provide (beta and Gamma functions) valuable tools in diverse areas of Engineering.

Course Outcomes:

At the end of the course the student should be able to,

1. Obtain solutions that describe the behaviour of the unknown function/functions involved.
2. Find the general solution, which is a family of functions that satisfy the equation.
3. Provide a powerful framework for quantifying and analyzing quantities that depend on multiple variables.
4. Provide essential tools for solving problems, analyzing data and understanding mathematical and physical phenomena.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	10	10
SEE	100	50
Total	150	100

Question paper pattern for CIE-I and CIE-II:

1. Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering two units (no multiple choice questions and No true or false questions).
2. In Part-B, any TWO full questions are to be answered.

Number of questions / Maximum marks	Sub divisions	Contents
Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Differential Equations-I & Differential Equations-II	Differential Equations-1
	Sub divisions shall not be mixed with Differential Equations-I & Differential Equations-II	Differential Equations-2
Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Integral Calculus , Beta, Gamma functions & Partial Differentiation	Partial differentiation
	Sub divisions shall not be mixed with Integral Calculus ,Beta, Gamma functions & Partial Differentiation	Integral Calculus and Beta, Gamma functions

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Part A is compulsory , it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total eight questions, any FOUR full questions are to be answered. Uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.
4. Sketches, figures and tables if any should be clearly drawn, as the same is scanned for printing.
5. The question paper should contain all the data / figures / marks allocated, with clarity.
6. paper should contain all the data / figures / marks allocated, with clarity.

IV Semester Syllabus

22UMA401C	Statistics and Probability Distributions	03 - Credits (3 : 0 : 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

UNIT – I	10 Hrs.

Statistics

Curve fitting by the method of least squares: $y = a + bx$, $y = ab^x$, $y = a + bx + cx^2$. Correlation, expression for the rank correlation coefficient and regression.

(RBT Levels: L1, L2 and L3)

UNIT – II Probability	10 Hrs.

Addition rule, conditional probability, multiplication rule, Baye"s rule. Discrete and continuous random variables-Probability density function, Cumulative distribution function, Problems on expectation and variance.

(RBT Levels: L1, L2 and L3)

UNIT – III Probability distributions	10 Hrs.

Binomial distributions, Poisson distributions and Normal distributions. Concept of joint probability, Joint probability distributions.

(RBT Levels: L1, L2 and L3)

UNIT – IV Markov chains	10 Hrs.

Introduction, Probability vectors, Stochastic Matrices, Fixed Points and Regular stochastic Matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

(RBT Levels: L1, L2 and L3)

References:

1. Numerical Methods for Engineers by Steven C Chapra & Raymond P Canale.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics By H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. Advanced Engineering Mathematics by E Kreyszig ,John Wiley & Sons.
5. Probability and stochastic processes by Roy D. Yates and David J. Goodman, wiley India pvt.ltd 2nd edition 2012.
6. Theory and problems of probability by Seymour Lipschutz (Schaum"s Series).

Course Objectives:

1. To apply the knowledge of Statistics in various Engineering fields.
2. To be acquired knowledge about predictions preferably on the basis of mathematical equations.
3. To be understand the principal concepts about probability.

Course Outcomes:

After completion of the course the students shall be able to,

1. Apply the least square sense method to construct the specific relation for the given group of data.
2. Solve problems on correlation and regression
3. Apply the concepts of probability
4. Apply the concepts of probability distributions
5. Apply the concept of Markov Chain for commercial and industry purpose.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	10	10
SEE	100	50
Total	190	100

Question paper pattern for CIE-I and CIE-II:

Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering Unit-I and Unit-II (no multiple choice questions and No true or false questions).

In Part-B, four questions are to be set as per the following table.

CIE	Number of questions / Maximum marks	Sub divisions	Covering entire unit
I	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-I
	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-II
II	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-III
	Two questions of 15 marks (Solve any one)	Sub divisions shall not be mixed within the unit	Unit-IV

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Question number 1 is compulsory, it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total of eight questions with two from each unit; with internal choice to be set uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.
4. In Part-B, any FOUR full questions are to be answered choosing at least one from each unit.
5. Sketches, figures and tables if any should be clearly drawn, as the same is scanned for printing.

The question paper should contain all the data / figures /

SUBJECT CODE: 22UEC402C	Signals and Systems	Credits: 04
L:T:P:S – **3:2:0:2**		CIE Marks: 50
Total Hours/Week: 05		SEE Marks: 50

UNIT-I	10 Hrs
Introduction to Continuous-time and Discrete-time Signals and Systems: Definition of signals and systems, sampling, classification of signals, elementary signals, basic operations on signals, interconnection of systems and operations, classification of systems and properties of systems **Self Study Component:** Introduction to time variant systems	
UNIT–II	**10 Hrs**
Time domain representation of LTI systems: Convolution sum, convolution integral, impulse response representation of systems, properties of impulse response. **Self Study Component:** Introduction to fast convolution-Winograd Algorithm	
UNIT–III	**10 Hrs**
Fourier and inverse Fourier transformation of signals: Introduction to complex sinusoidal signals and their use in Fourier representation of periodic signals, continuous time Fourier series (CTFS), discrete time Fourier series (DTFS), continuous time Fourier transform (CTFT), discrete time Fourier transform (DTFT), inverse discrete Fourier transformation (IDTFT), properties of DTFT, **Self Study Component:** Basics of discrete Cosine transform	
UNIT–IV	**10 Hrs.**
Z -Transforms: Introduction, properties of ROC, properties of Z-transform, relation between Z - transform and Fourier transform. Inverse Z-transform, transform domain analysis of LTI systems, transfer function, stability and causality, solution of difference equations using Z-transform. **Self Study Component:** Basics of Hilbert transform	
Practical Component of Professional Core Course (PCC) "Signals and Systems"	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc, tools to be used. 1. MATLAB **2.** Python **3.** SCILAB.	
Reference Books *	
1. Simon Haykin and Barry Van Veen, "Signals and systems", Edition 2, John Wiley Indian Ed, 2008. 2. Alan V. Oppenheim, Alan S. Willsky and Syed Hamid Nawab, "Signals and Systems", Edition 2, PHI, 2014.	
Web links and Video Lectures (e-Resources): 1. https://nptel.ac.in/courses/117101055 2. https://www.digimat.in/nptel/courses/video/108104100/L02.html 3. https://nptel.ac.in/courses/117104074	
Course Outcomes**	

After completion of the course student will be able to

1. Perform different operations on signals and systems.
2. Characterize different class of signals and systems in time and transform domain
3. Compute system response to arbitrary inputs using time and frequency domain tools.
4. Explore the concepts of signals and systems through implementation using MATLAB/SCILAB/Python.

List of Experiments under Self Study Component

Sl. No.	Experiments
1	Generation of Signals: Periodic, Aperiodic, Discrete, Continuous and Complex Signals
2	Operation on discrete and continuous time signals: Amplitude scaling, Time Scaling, Time shift
3	Determination of frequency and time period of continuous time and discrete time periodic signals
4	Response of LTI systems using convolution sum and convolution integral
5	LTI system classification using impulse response.
6	Verification of sampling theorem and Parsaval's theorem
7	Fourier series of continuous time and discrete time periodic signals
8	Fourier transform of continuous time and discrete time periodic signals
9	Verification of time shift and frequency shift properties of DTFT
10	Computation of inverse DTFT
11	Computation of Z-Transform and plotting ROC
12	Solution of difference equations using Z-Transform

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	3	1	0	0	0	0	0	0	0	0	0	3	0	0
CO3	3	3	1	0	0	0	0	0	0	0	0	0	3	0	0
CO4	3	2	1	0	0	0	0	0	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC403C	Analog Circuit Design	Credits: 04
L:T:P:S– 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs
MOS Differential Amplifiers: Introduction to Current Mirror – Basic, Wilson and Cascode Current Mirror, MOSFET Basic Differential Pair, Large Signal and Small Signal Analysis of Differential Amplifier, Differential Amplifier with Active Load, Differential Amplifier Frequency Response. **MOS Feedback Amplifiers:** Introduction to Feedback, Basic Feedback Concepts, Ideal Feedback Topologies - Series – Shunt ,Shunt - Series, Series - Series, Shunt - Shunt Amplifiers.	
UNIT–II	**10 Hrs**
Operational Amplifier and Applications: Introduction to op-amp, DC and AC amplifiers, op-amp as summing, scaling, and averaging amplifiers, differential amplifiers, instrumentation amplifier, I/V and V/I converter, precision rectifier, peaking amplifier	
UNIT–III	**10 Hrs**
Comparators and Waveform Generators: Comparator and its applications - Schmitt trigger, Oscillators-Barkhausen Criterion ,Phase-shift and Wein-bridge oscillators, Square, Triangular and Saw- tooth wave function generators **Active filters:** Filter classifications: First and second order Low-pass and High pass filter designs, Band pass filter, band reject, all pass filter	
UNIT–IV	**10 Hrs.**
Data Converters: Sample-and-hold circuits, **DAC:** Basics, D/A conversion using binary weighted resistors and R-2R resistors, **ADC:** DAC based ADC, Successive approximation ADC. Special Function ICs: IC 555 timer, block diagram, Astable and Monostable operations and applications. **PLL:** Block diagram, IC 565 pin diagram	
PRACTICAL COMPONENT OF IPCC	
Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc, tools to be used. Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Proteus, Simulink, eSim, Psim)	
Reference Books *	

1. Ramakant A Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4thEdition, Pearson Education, 2018.
2. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, “Microelectronic Circuits: Theory and Applications”, 7th Edition, Oxford University Press, New York, 2014.
3. J. D. Roy Choudhury, “Linear Integrated Circuits”, 5th Edition, New-Age International Publishers, New Delhi, 2018.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108/105/108105158/
2. https://archive.nptel.ac.in/courses/108/108/108108111/
3. https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English
4. https://psim.software.informer.com/11.1/

Course Outcomes**
After completion of the course student will be able to 1. Analyze the different active biasing techniques and MOSFET-based differential amplifiers and their frequency response characteristics. 2. Apply the feedback topologies and approximations in the design of amplifiers using op-amps 3. Design and analyze different waveform generators and filters using op-amps 4. Develop the skill to analyze data converter circuits using op-amps and multivibrators using 555 timer.

Sl. No.	Experiments
1	Design of Feedback Amplifiers for the given Specifications- Series -Shunt and Shunt-Shunt Feedback Amplifier.
2	Design and verification of summing, scaling and averaging, substractor circuits using op-amp.
3	Design and verification of Schmitt trigger for given specifications.
4	Design and verification of second order active low pass and high pass filters.
5	Design and verification of second order active band pass filter.
6	Design of Oscillators for the given Specifications - RC Phase shift Oscillator.
7	Design of Oscillators for the given Specifications – Wein bridge Oscillator.
8	Design and verification of integrator and differentiator for given specifications.
9	Design and verification of Schmitt trigger.
10	Generation of square wave using SE/NE 555 timer for given specifications.
11	Design and verification of monostable multivibrator for given specifications.
12	Convert the given digital signal in to analog signal using R-2R resistors.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**
CO2	**3**	**3**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**
CO3	**3**	**3**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**
CO4	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**

SUBJECT CODE: 22UEC404C	Analog and Digital Communication	Credits: 04
L:T:P:S – 3:0:2:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs

Linear modulation: Baseband and carrier communication, time domain and frequency domain description, generation and detection of Amplitude Modulation (AM) waves.
DSB-SC modulation: Time and frequency domain representation, generation and detection of DSB-SC modulated waves.
SSB modulation: Time domain representation of SSB signal, generation and detection of SSB modulated waves, Quadrature Amplitude Modulation (QAM).
Vestigial sideband modulation: Frequency domain representation, generation and detection of VSB,comparison of amplitude modulation techniques, superheterodyne receiver.

UNIT–II	10 Hrs

Angle modulation: Concept of angle modulation, relation between frequency and phase modulation, bandwidth of angle modulated wave.
Generation of FM: direct and indirect methods, PLL, demodulation of FM, pre-emphasis and de-emphasis, FM radio

UNIT–III	10 Hrs

Digital Communication: Model of digital communication systems Sampling process: Sampling Theorem, uniform and non-uniform quantization, Quadrature sampling of Band pass signal, reconstruction of a message from its samples, signal distortion in sampling. Line codes, unipolar, polar and Manchester codes and their power spectral densities.

UNIT–IV	10 Hrs.

Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques (ASK,PSK, FSK), Probability of error for each ASK, PSK, FSK. Coherent quadrature modulation techniques, MSK, (without derivation of probability of error equation). Non-coherent binary modulation techniques (FSK and DPSK).

PRACTICAL COMPONENT OF IPCC (Number of Experiments should be in the range of 10 to 15)

Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. (preferably open sources):

1. Simulation using Matlab/Scilab
2. Verification using Hardware components

Reference Books *

1. B. P. Lathi"Modern Digital and Analog Communication Systems", 3rdEdition, Oxford University, 2006.
2. George Kennedy "Electronic Communication Systems", 3rdEdition, Tata McGraw Hill Publication, 1984.
3. B.P.Lathi"CommunicationSystems",3rdEdition,B.S.Publications,2009.
4. SimonHaykin"CommunicationSystems",3rdEdition,JohnWiley andSons,2005.
5. Simon Haykin, "Digital communications", John Wiley, Edition 2014.

6. John. G. Proakis, &Masoulsalehi" Fundamental of Communication System" Pearson Education, Edition 2014.
7. Bernard Sklar and Prabitrakumary Ray, "Digital Communication Fundamentals and Applications", Pearson Publications, 2010.
8. K. Sam Shanmugan, "Digital and Analog Communication Systems", John Wiley & Sons,2006.

Web links and Video Lectures (e-Resources):

1. https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English
2. www.mathworks.com.

Course Outcomes**

After completion of the course student will be able to

1. Demonstrate generation and detection of analog and digital modulation techniques.
2. Explain the principles and applications of AM, FM and PM in various communication systems.
3. Apply various digital modulation techniques for signal transmission.
4. Distinguish various line coding schemes used for digital data transmission.
5. Distinguish different coherent and non-coherent digital modulation techniques

Sl. No.	Experiments
1	To construct an amplitude modulator circuit to satisfy under modulation condition and generate amplitude modulated signal and simulate amplitude modulated wave in time domain using Matlab/Scilab
2	To generate DSB-SC AM signal using balanced modulator. Simulate DSB-SC AM modulator in time domain using Matlab/Scilab
3	Simulate FM modulated wave in time domain using Matlab/Scilab
4	To study PCM of a given input signal using Matlab/Scilab
5	To study DPCM of a given input signal using Matlab/Scilab.
6	To study Delta Modulation of a given signal using Matlab/Scilab.
7	Perform pre-emphasis and de-emphasis usingMatlab/Scilab.
8	Perform given signal conversion using different line coding techniques.
9	To study different coherent binary modulation techniques (ASK, FSK,PSK)and simulate using Matlab/Scilab.

10	To study different non-coherent binary modulation techniques (FSK and DPSK) and simulate using Matlab/Scilab.
11	Design and verification of Modulation and demodulation AM signal.
12	Design and verification of Modulation and demodulation FM signal.
13	Realization of pre-emphasis and de-emphasis circuit.
14	Verification of sampling theorem .
15	Generation and detection of ASK ,FSK, and PSK signal.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO2	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO3	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO4	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0
CO5	3	3	3	2	2	1	1	1	2	1	0	1	3	0	0

SUBJECT CODE: 22UEC405C(PCC)	ARM Microcontroller	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

Course Objectives **

1. Students will Studies the architectural inheritance of the ARM architecture, understanding of its development in Assembly Language Programming.
2. Studies utilizing ARM development tools to write and debug assembly language programs, along with deep comprehension of the ARM programmer's model.
3. Students learn writing and executing simple ARM assembly language programs, incorporating data processing, data transfer, and control flow instructionseffectively.
4. Students develop skill in using the ARM instruction set to perform various operations, including branching, data processing, and coprocessor instructions.
5. Students learn implementing ARM architecture support for high-level languages,including working with data types, floating-point operations, expressions, conditional statements, functions, and memory management.

Course Outcomes**

After completion of the course student will be able to

1. Analyze and explain the architectural inheritance of the ARM architecture, demonstrating acomprehensive understanding of its development in Assembly Language Programming.
2. Demonstrate proficiency in utilizing ARM development tools to write and debug assemblylanguage programs, showing a deep comprehension of the ARM programmer's model.
3. Exhibit competence in writing and executing simple ARM assembly language programs, incorporating data processing, data transfer, and control flow instructionseffectively.
4. Demonstrate skill in using the ARM instruction set to perform various operations, includingbranching, data processing, and coprocessor instructions.
5. Attain proficiency in implementing ARM architecture support for high-level languages, including working with data types, floating-point operations, expressions, conditional statements, functions, and memory management.

UNIT-I	10 Hrs
The ARM Architecture: The Acorn RISC Machine, Architectural inheritance, The ARM programmer's model, ARM development tools, Example and exercises. **ARM Assembly Language Programming:** Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs, Examples and exercises	
UNIT–II	**10 Hrs**
The ARM Instruction Set : Introduction , Exceptions , Conditional execution , Branch and Branch with Link (B, BL), Branch, Branch with Link and exchange (BX, BLX) , Software Interrupt (SWI), Data processing instructions, Multiply instructions , Count leading zeros (CLZ - architecture v5T only), Single word and unsigned byte data transfer instructions , Half-word and signed byte data transfer instructions, Multiple register transfer instructions , Swap memory and register instructions (SWP), Status register to general register transfer instructions , General register to status register transfer instructions.	
UNIT–III	**10 Hrs**
The ARM Instruction Set continued: Coprocessor instructions, Coprocessor data operations, Coprocessor data transfers, Coprocessor register transfers, Example and exercises. **Architectural Support for High-Level Languages:** Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Use of memory, Run-time environment, Examples andexercises.	
UNIT–IV	**10 Hrs.**
The Thumb Instruction Set : The Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation , Example and exercises.	

Suggested Simulation/Modelling/Design/Verification/Hardware Boards/etc. (preferably open sources):

1. Develop and test Program using ARM7TDMI/LPC2148.
2. Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.

Reference Books *

1. Steve Furber, “ARM System on Chip Architecture”, Edition 2, Pearson Education Limited, 2000.
2. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer‟s Guide”, Morgan Kaufmann Publishers, An imprint of Elsevier, 2004.
3. Joseph Yiu, “The definitive guide to the ARM CORTEX-M3”, Newnes, Second edition.
4. William Hohl and Christopher Hinds, “ARM Assembly Language Fundamentalsand Techniques”, second edition, CRC Press, 2015.
5. Trevor Martin, “The Insider‟s Guide Philips ARM®7 based Microcontrollers An Engineer‟s Introduction To The LPC2100 Series” Hitex (UK) Ltd.,2005.
6. Gibson, ARM Assembly Language an Introduction, Edition 2, 2007.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. https://youtu.be/gPBsoOefyUk
3. https://youtu.be/R8bH_pary3Y
4. https://youtu.be/-Qmne2YuwDI
5. https://pdfkeys.com/download/1304945-Arm_Microcontroller_Muhammad_Ali_Mazidi.pdf

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO2	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO3	3	3	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO4	3	2	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO5	3	2	2	1	3	1	1	1	2	1	1	2	0	3	0

Course Title: ARM Microcontroller Lab(PCC)		Course Code: 22UEC406L
Credits: 1.0		Contact Hours: 3 Hrs/Week
CIE Marks: 50	SEE Marks: 50	Total Marks: 100

Course Objectives:

- To have hands-on experience in using ARM7TDMI/LPC2148. family microcontrollers.
- To provide practical knowledge of ARM7TDMI/LPC2148. assembly language programming.
- To have exposure in using Keil compiler and embedded C programming.
- To understand different inbuilt peripherals in ARM7TDMI/LPC2148.family and their interfacing.
- To encourage the students in building embedded applications.

Course Outcomes:

- Able to get fundamental concepts of ARM7TDMI/LPC2148. microcontroller from practical point of view.
- Able to write efficient programs in assembly level language of the RM7TDMI/LPC2148. microcontroller.
- Able to carry out interface between the ARM7TDMI/LPC2148.microcontroller and peripheral devices so that they can design and develop a complete microcontroller based systems (projects).
- Able to develop the ability to use embedded C language to perform a defined task.

Suggested Simulation/Modelling/Design/Verification/Hardware Boards/etc. (preferably open sources):

- Develop and test Program using ARM7TDMI/LPC2148.
- Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.

Sl. No.	Experiments
	Part-A
1	Write a program to multiply two 16 bit binary numbers.
2	Write a program to find the sum of first 10 integer numbers.
3	Write a program to find factorial of a number.
4	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers.
7	Write a program to arrange a series of 32 bit numbers in ascending/descending order.
8	Write a program to count the number of ones and zeros in two consecutive memory locations.
	Part-B

9	Display “Hello World” message using Internal UART.
10	Interface and Control a DC Motor.
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13	Interface a DAC and generate Triangular and Square waveforms.
14	Interface a 4x4 keyboard and display the key code on an LCD.
15	Demonstrate the use of an external interrupt to toggle an LED On/Off.
16	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO2	3	3	3	1	3	1	1	1	2	1	0	1	**0**	3	0
CO3	3	3	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO4	3	2	3	1	3	1	1	1	2	1	2	1	**0**	3	0
CO5	3	2	2	1	3	1	1	1	2	1	1	2	0	3	0

22UHS424C	UNIVERSAL HUMAN VALUES-II	Credit: 01
L:T:P - 1 : 0: 0		CIE Marks: 50
Total Hours/Week:01		SEE Marks: 50

UNIT-I **(4 Hrs)**

Introduction to Value Education: Right Understanding; Relationship and Physical Facility; Understanding Value Education; Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspiration-Current Scenario and Method to Fulfill the Basic Human Aspirations.

UNIT–II **(4 Hrs)**

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT–III **(4 Hrs)**

Harmony in the Family and Society and Nature: Harmony in the Family – the Basic Unit of Human Interaction; 'Trust' – the Foundational Value in Relationship; 'Respect' – as the Right Evaluation: Other Feelings, Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order; Understanding Harmony in the Nature; Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature.

UNIT–IV **(3 Hrs)**

Implications of the Holistic Understanding – a Look at Professional Ethics

Definitiveness of (Ethical) Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order; Competence in Professional Ethics; Holistic Technologies, Production Systems and Management Models; Strategies for Transition towards Value-based Life and Profession.

Reference Books

1. R R Gaur, R Sangal, G P Bagaria, „Human Values and Professional Ethics", , Excel Books, New Delhi, 2010.
2. A. Nagaraj, Jeevan VidyaEkParichaya, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
4. Annie Leonard,The Story of Stuff (Book), Simon & Schuster, 2011.
   Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, Public Affairs Press of Washington, DC. 1948.
6. E. F Schumacher, Small is Beautiful,. Blond & Briggs, 1973.
7. Cecile Andrews, Slow is Beautiful, New Society Publishers, 2006.
8. J C Kumarappa, Economy of Permanence, Akhil Bharat Sarva-Seva-Sangh, Rajghat, Kashi, 1958.
9. Pandit Sunderlal, Bharat Mein AngrejiRaj,Publications Division, M/O Information & Broadcasting, Govt. of India, 2016
10. Dharampal,Rediscovering India, Society for Integrated Development of Himalayas, 2003

11. Gandhi, Mohandas K.Hind Swaraj or Indian Home Rule Ahmedabad, Nava jivan Pub. House, 1946.
12. India Wins Freedom, Maulana Abdul Kalam Azad, Orient Black Swan, 1988.
13. Romain Rolland, Gandhi, Romain Rolland (English), Srishti, 2000.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO1: Explore holistic vision of life - themselves and their surroundings.

CO2: Develop competence and capabilities for maintaining Health and Hygiene.

CO3: Analyse various problems in life, family, Society and in handling problems with Sustainable Solutions.

CO4: Apply values to their own self in different day-to-day settings in real life and in handling problems with sustainable solutions.

CO5: Adopt the value of appreciation and aspiration for excellence and gratitude for all.

Course Articulation Matrix

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							3	2	3			1			
CO2	-	-	-	-	-	3	3	1	1			1			
CO3	-	-		-	-	3	3	2	1	-		1		-	
CO4			-			2	2	3	2	-	-	1	-	-	
CO5								3				1			

22UMA400M	Bridge Course Mathematics-II	Credits – 0; Mandatory Course L-T-P:(3 : 0 : 0)
Hours / Week : 03		CIE Marks : 50
Total Hours : 40		SEE Marks : 50

Differential Calculus (10 Hrs.)

Review of elementary calculus, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation. Taylor‟s and Maclaurin‟s series expansions for one variable (without proof) problems

(RBT Levels: L1, L2 and L3)

Vector Differentiation (10 Hrs.)

Introduction, Scalar and vector fields**.** Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrigational vector fields- problems.

(RBT Levels: L1, L2 and L3)

Laplace Transform (10 Hrs.)

Introduction, Definition of Laplace Transform, Laplace Transform of standard functions, Properties: Shifting, differentiation, Integral and division by t. Periodic function, Heaviside‟s Unit step function.

(RBT Levels: L1, L2 and L3)

Inverse Laplace transforms (10 Hrs.)

Properties, Convolution theorem-problems, Solutions of linear differential equations.

(RBT Levels: L1, L2 and L3)

References:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Erwin Kreyszing‟s Advanced Engineering Mathematics volume I and volume II, wiley India Pvt.Ltd., 2014.
3. Elementary Differential Equations by Earl D. Rainville and Phillip E, Bedient, Sixth Edition
4. Erwin Kreyszing‟s Advanced Engineering Mathematics, wiley India Pvt.Ltd., 2014.

Course Objectives:

This course will enable students to

1. Provide (Polar Curves) an alternative way of representing functions compared to the Cartesian coordinate system.
2. Analyze vector valued functions and understand the behavior of various physical quantities in both theoretical and practical contexts.

3. Simplify the process linear ordinary differential equations. It transforms the differential equations, which may be difficult to solve directly, into algebraic equations, making the problem more tractable.

Course Outcomes:

At the end of the course the student should be able to,

1. Use (polar curves) to model and analyse various physical phenomena, such as orbits of celestial bodies, antenna radiation patterns and fluid flow in circular systems.
2. Find the velocity and acceleration vectors of objects in motion.
3. Find applications in various fields of engineering, including control systems, circuit analysis, fluid dynamics, heat transfer and many more.
4. Solve differential equations, understand systems responses and gain insights into the behaviour of various engineering and physical systems in the time domain.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	40	20
CIE-II	40	20
Assignments/ Quizzes/Case Study/ Course Project/Term Paper/Field Work	20	10
SEE	100	50
Total	200	100

Question paper pattern for CIE-I and CIE-II:

1. Question paper consists Part-A and Part-B. Part A is compulsory, it consists of short answer questions of 1 or 2 marks, covering two units (no multiple choice questions and No true or false questions).

2. In Part-B, any TWO full questions are to be answered.

CIE	Number of questions / Maximum marks	Sub divisions	Contents
I	Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Differential equations-1 and Differential equations-2	Differential Equations-1
		Sub divisions shall not be mixed with Differential equations-1 and Differential equations-2	Differential Equations-2
II	Four questions of 15 marks (Solve any two)	Sub divisions shall not be mixed with Laplace Transform and Inverse Laplace transform	Laplace Transform
		Sub divisions shall not be mixed with Laplace Transform and Inverse Laplace transform	Inverse Laplace Transform

Question paper pattern for SEE:

1. Question paper consists Part-A and Part-B. Question number 1 is compulsory, it consists of short answer questions of 1 or 2 marks, covering entire syllabus (no multiple choice questions and No true or false questions, 50% of questions must be L3 and L4 level).
2. In Part-B total of eight questions with two from each unit; with internal choice to be set uniformly covering the entire syllabus.
3. Each question carries 20 marks and should not have more than four subdivisions.

In Part-B, any FOUR full questions

V Semester

SUBJECT CODE: 22UEC501C	Digital Signal Processing	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Discrete Fourier Transform: Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, its relationship with other transforms, properties: multiplication of two DFTs, circular convolution and additional properties of DFT. Application of DFT in linear filtering: overlap add and overlap save method.	
UNIT–II	**10 Hrs.**
Fast Fourier Transform Algorithms: Need for efficient computation of DFT, Radix 2 FFT algorithms for computation of DFT and IDFT: Decimation in time and decimation in frequency algorithms. Goertzel algorithm and chirp-Z transform algorithm.	
UNIT–III	**10 Hrs.**
IIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters. Design of IIR filters from analog filters (i.e. Butterworth and Chebyshev), Transformation techniques: Impulse invariance method, Approximation of derivative (Backward difference and Forward difference) method. Bilinear transformation method.	
UNIT–IV	**10 Hrs.**
FIR filter design: Introduction to FIR filters, Design of FIR filters using windowing (Rectangular, Hamming, Hanning and Bartlet) method, FIR filter design using frequency sampling method. Implementation of discrete time systems - Structures for IIR and FIR systems: Direct form I, Direct form II, Cascade and Parallel realization.	

Reference Books *

Textbook:

1. Proakis and Manolakis, “Digital Signal Processing-Principles Algorithms and Applications” PHI Publication, III Edition, 1997.

Reference Books:

1. Oppenheim and Schaffer, “Discrete Time Signal Processing” PHI Publication, III Edition, 2003.

Course Outcomes**

After completion of the course student will be able to

1. **Compute and use DFT for linear filtering applications.**
2. **Calculate DFT and IDFT using FFT and IFFT algorithms.**
3. **Design IIR filters using Butterworth and Chebyshev approximations and draw their structures.**
4. **Design FIR filters using windowing and frequency sampling techniques and draw their structures.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	0	1	0	0	0	0	0	0	0	3	0	0
CO2	3	3	1	0	1	0	0	0	0	0	0	0	3	0	0
CO3	3	3	3	0	1	0	0	0	0	0	0	0	3	0	0
CO4	3	2	3	0	1	0	0	0	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC502C	Control Engineering	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	xx Hrs.
System modeling: Definition of control system, Concept of feedback and its significance, open loop and closed loop systems, Modeling of Electrical, Mechanical and Electromechanical systems, Differential equations of physical system. Transfer function, Block diagram representation and Reduction technique, Signal flow graph representation and reduction using Mason's gain formula.	
UNIT–II	**xx Hrs.**
Time domain analysis of control systems: Introduction, standard test signals, Unit step response of a second order system, Steady state error analysis, time domain specifications. Stability analysis technique: Concept of stability, Location of Roots in the s-plane for stability, methods of determining stability, Routh-Hurwitz stability criterion.	
UNIT–III	**xx Hrs.**
Root-Locus Technique: Introduction, Procedure for constructing Root-locus. Stability analysis using root locus. Frequency Domain Analysis: Introduction, Bode plots, Gain and Phase cross over frequency, gain margin, phase margin, Frequency domain specifications-resonant peak, resonant frequency, and bandwidth.	
UNIT–IV	**xx Hrs.**
Polar plots, Nyquist stability criterion; Principle of argument, mapping, Nyquist path, Nyquistcriterion, Nyquist Plot and stability analysis. State Space Analysis: Introduction, concept of state and variables, state model, Non homogeneous solution of a state equation.	

Reference Books *

1. Nagrath and Gopal, "Control System Engineering", New Age publication.
2. K. Ogeta, "Modern control engineering", Person education, Asia/PHI 4th edition, 2002.
3. Benjamin C.Kuo, "Automatic Control Systems", PHI 7th edition.
4. Richard C. Dorf and Robert. H. Bishop, "Modern Control Systems", Person Education, 8 thEdition, 2002.
5. M. Gopal, "Control Systems-Principles and Design", TMH, 2nd Edition, 2002.
6. David. K. Chng, "Analysis of Linear systems", Narosa publishing house, 1996

Course Outcomes**

After completion of the course student will be able to

1. Mathematically model electrical, mechanical and electromechanical control systems.
2. Characterize the control systems in time domain.
3. Analyze stability of a control system using root locus technique and frequency domain analysis using Bode plotting techniques.
4. Determine the stability of control systems using polar and Nyquist plotting technique and represent the control systems using state space techniques.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	-	2	2	-	-	-	-	-	-			
CO2	3	2	3	-	2	1	-	-	-	-	-	-			
CO3	3	2	3	-	3	-	-	-	1	-	-	-			
CO4	2	1	1	-	2	1	-	-	1	-	-	**1**			

SUBJECT CODE: 22UEC503C	Computer Networks	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Layered tasks, OSI Model, Layers in OSI model, TCP/IP Suite, Addressing, Data Link Control: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, HDLC, PPP.	
UNIT–II	**10 Hrs.**
MultipleAccesses:Randomaccess,Controlledaccess,Channelization,WiredLAN,Ethernet,IEEE standards,StandardEthernet.Changesinthestandards,FastEthernet,GigabitEthernet,Connecting LANs, Backbone and Virtual LANs	
UNIT–III	**10 Hrs.**
Network Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 Transition from Ipv4 to Ipv6, Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols.	
UNIT–IV	**10 Hrs.**
Transport layer Process to process Delivery, UDP, TCP, Application Layer: Domain name system, Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS messages, Types of Records, Registrars, Dynamic Domain Name System, Encapsulation.	

Reference Books *

1. DataCommunicationandNetworking,"BehrouzA.Forouzan",4th Edition,TMH,India,2006.
2. AndrewS.Tanenbaum,"Computernetworks",Prentice-Hall,2010.
3. WilliamStallings,"DataandComputerCommunications",Prentice-Hall,2007.

Course Outcomes**

After completion of the course student will be able to

1. **Master the terminology and concepts of the OSI reference model and the TCP/IP reference model**
2. **Master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks**
3. **Identify, compare and contrast different techniques and design issues of core functions such as addressing, routing, internetworking, switching, multiplexing, error and flow control, medium access and coding.**
4. **Become familiar with widely-used Internet protocols such as TCP/IP, UDP,etc.**

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
** **Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	2	1	1	1	0	0	0	0	0	1	0	3
CO2	3	3	2	2	1	1	1	1	0	0	0	0	1	0	3
CO3	3	2	3	2	1	1	1	0	1	1	1	0	1	0	3
CO4	3	3	3	2	1	1	2	1	1	1	1	1	1	0	3

Subject Code:22UEE504L	Digital Signal Processing Laboratory	Credit: 1.0
L:T:P-0-0-3		CIE marks: 50
Total Hours/Week :03		SEE Marks :50

List of Experiments

1. Generation of different analog and digital signals (impulse, step, ramp, sine, cosine, square, rectangular and triangular) with given amplitude, frequency, phase and duration
2. Verification of sampling theorem.
3. Implementation of amplitude scaling, time scaling, time reversal and time shift operations on given signal.
4. Response of continuous time and discrete time LTI systems to a given input.
5. Fourier series of given continuous time and discrete time periodic signal.
6. Fourier transform of given continuous time and discrete time a periodic signal
7. N point DFT of a given sequence of length L when (a) N < L (b) N = L and (C) N >L and their corresponding IDFT.
8. Verification of conjugate symmetry property of DFT
9. Implementation of linear convolution using DFT and IDFT.
10. Design and implementation of IIR filter to meet given specifications.
11. Design and implementation of FIR filter using different windows to meet given specifications.
12. Implementation of linear and circular convolution of given two sequences using DSP processor.

Course Outcomes**

After Completion of the course student will be able to

1. Generate different analog and digital signals of given amplitude, frequency, phase and duration
2. Implement different operation on digital and analog signals
3. Convert given time domain signal into frequency domain vice versa
4. Design and implement IIR and FIR filters to meet the given specifications.
5. Implement simple DSP algorithms on DSP processor

* Books to be listed as per the format with deceasing level of coverage of syllabus

** Each CO to be written with proper action word and should be assessable and quantifiable

Course outcomes	Programme Outcomes (Pos)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	0	1	0	0	0	0	0	0	1	3	0	0
CO2	3	2	2	0	1	0	0	0	0	0	0	1	3	0	0
CO3	3	2	1	0	1	0	0	0	0	0	0	1	3	0	0
CO4	3	2	3	0	1		0	0	0	0	0	1	3	0	0
CO5	3	2	3	0	1	0	0	0	0	0	0	1	3	0	3

SUBJECT CODE: 22UEC506E	Internet of Things	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

Course Objectives:

1. To understand the fundamentals of IoT and explore IoT technologies and architecture
2. To learn IoT protocols
3. To understand the fundamentals of data analytics in IoT
4. To develop IoT applications

UNIT-I	10 Hrs.
Introduction to Internet of Things (IoT): Definition of IoT, History and growth of internet and IoT, Application areas and focus of IoT, Characteristics of IoT, Things in IoT, IoT Stack **Enabling Technologies:** Sensors, Cloud Computing, Big data Analytics, Communication Protocols. IoT Challenges. IoT Levels: Level 1, Level 2, Level 3, Level 4, Level 5.	
UNIT–II	**10 Hrs.**
Protocols for IoT-Messaging and Transport Protocols: Introduction, Messaging Protocols, Transport Protocols. **Protocols for IoT-Addressing and Identification:** Introduction, IPv4, IPv6, URI **Cloud for IoT:** Introduction, types of cloud services, IoT with Cloud, Selection of cloud with IoT applications.	
UNIT–III	**10 Hrs.**
Data analytics-Visualizing the Power of data from IoT: Introduction to data analysis, Machine learning: Supervised Learning, Unsupervised Learning, Types of Machine Learning Models: Classification, Regression, Clustering. Model Building Process: Training, testing and validation of the model, Modelling Algorithms: Decision tree, Linear Regression, Logistics Regression, k Means.	
UNIT–IV	**10 Hrs.**
Application Building with IoT: Smart perishable tracking/smart transportation Smart healthcare, IoT based application to monitor water quality, Smart warehouse monitoring, Smart retail.	

Reference Books *

Text Books:

1. Shriram K. Vasudevan, Abhishek S., Sundar Balakrishnan, "Internet of Things", 1st Edition, Wiley, 2019.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2nd Edition June 2022

Reference Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016

1.Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015

Course Outcomes**

A student who successfully completes this course should be able to

1. Define and describe about different IoT characteristics

2. Apply IoT protocols
3. Analyze IoT data using machine learning
4. Design and implement IoT applications

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	0	2	0	2	2	3	2	2	2	3	1	0	0	1
CO2	3	0	2	0	2	2	3	2	2	2	3	1	0	0	1
CO3	3	0	2	0	2	2	3	2	2	2	3	1	0	0	1
CO4	3	0	2	0	2	2	3	2	2	2	3	1	0	0	1
CO5	3	0	2	0	2	2	3	2	2	2	3	1	0		1

SUBJECT CODE: 22UEC507E	Verilog programming	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to Verilog: Introduction, Computer-Aided Design, Hardware Description Languages, Verilog Description of Combinational Circuits, Verilog Modules, Verilog Assignments, Procedural Assignments, Modeling Flip-Flops Using Always Block, Always Blocks Using Event Control Statements, Delays in Verilog, Compilation, Simulation, and Synthesis of Verilog Code, Verilog Data Types and Operators, Simple Synthesis Examples, Verilog Models for Multiplexers, Modeling Registers and Counters Using Verilog Always Statements, Behavioral and Structural Verilog, Constants, Arrays,

UNIT–II	10 Hrs.

Introduction to Verilog cont.: Loops in Verilog, Testing a Verilog Model.
Design Examples: Introduction, BCD to 7-Segment Display Decoder, A BCD Adder, 32-Bit Adders, Traffic Light Controller, State Graphs for Control Circuits, Scoreboard and Controller, Synchronization and De-bouncing, A Shift-and-Add Multiplier, Array Multiplier, A Signed Integer/Fraction Multiplier, Keypad Scanner, Binary Dividers.

UNIT–III	10 Hrs.

Additional Topics in Verilog: Introduction, Verilog Functions, Verilog Tasks, Multivalued Logic and Signal Resolution, Built-in Primitives, User-Defined Primitives, SRAM model, Model for SRAM Read/Write System, Rise and Fall Delays of Gates, Named Association, Generate Statements, System Functions, Compiler Directives, File I/O Functions, Timing Checks.
Hardware Testing and Design for Testability: Introduction, Testing Combinational Logic, Testing Sequential Logic, Scan Testing, Boundary Scan, Built-In Self-Test.

UNIT–IV	10 Hrs.

Component Test and Verification: Test-bench, Combinational circuit testing, Sequential circuit testing, Test-bench Techniques, Simulation control, Limiting data sets, Applying synchronized data, Synchronized display of results, An interactive test-bench, Random time intervals, Buffered data application, Design Verification, Assertion Verification, Assertion verification benefits, Open verification library, Using assertion monitors, Assertion templates

Reference Books *

1) Charles Roth, Lizy Kurian John, and ByeongKil Lee "Digital Systems Design Using Verilog" Cengage Learning, 2016
2) Zainalabedin Navabi "Verilog Digital System Design" Second Edition, Mcgraw Higher Ed,2008
3) Palnitkar, Samir. “Verilog HDL: a guide to digital design and synthesis” Vol. 1. Prentice Hall Professional,2003.
4) Sagdeo, Vivek. “The complete Verilog book”. Springer Science & Business Media,2007.
5) Smith, Douglas J., and Alex Foreword By-Zamfirescu. “HDL Chip Design: A practical guide for designing, synthesizing and simulating ASICs and FPGAs using VHDL or Verilog” Doone Publications,1998.
6) Bhasker, Jayaram. “A Verilog HDL Primer”. Star Galaxy Publishing,1999.

Course Outcomes**

After completion of the course student will be able to write

1. **Verilog code for combinational and sequential circuits.**
2. **Verilog code for a simple digital system for given specifications using different design styles.**

3. **Verilog code using advanced Verilog Concepts.**
4. **Develop Test benches to automate simulation and verification of design.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	0	1	1	3	0	0	0	0	0	0	0	0	3	0
CO2	1	0	1	1	3	0	0	0	0	0	0	0	0	3	0
CO3	1	0	1	1	3	0	0	0	0	0	0	0	0	3	0
CO4	1	0	1	1	3	0	0	0	0	0	0	0	0	3	0

SUBJECT CODE: 22UEC508E	Mobile Communications	Credits: 03
L:T:P - N_L :02 N_T:00 N_P:00		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

UNIT-I	10 Hrs.
Wireless standard organizations. Wireless transmission: Frequencies for radio communication, signals, antennas, signal propagation. Medium access control: Motivation for specialized MAC, SOMA, FDMA, TOMA, CDMA.	
UNIT–II	**10 Hrs.**
Telecommunication systems: GSM, UMTS and IMT2000, 4GLTE networks, 5G networks over view. Broadcast system: Overview, cyclical repetition of data, digital audio broadcasting, and digital video broadcasting.	
UNIT–III	**10 Hrs.**
Wireless LAN: IEEE802.11 system architecture, protocol architecture, physical layer, medium access controller, MAC management. 802.11b. and 802.11a. Bluetooth: user scenarios, architecture, radio layer.	
UNIT–IV	**10 Hrs.**
Mobile network layer dynamic host configuration protocol, mobile Ad-hoc network. Mobile transport layer: Traditional TCP , classical TCP improvement, TCP over2.5/3G wireless network, performance enhancing proxies.	

Reference Books *

1. Jochen Schiller, 2003 "Mobile Communications", second edition PearsonEducation.
2. Gary Mullett, 2006 “Introduction to wireless telecommunication systems and networks ", First Edition Cengage learning

Course Outcomes**

After completion of the course student will be able to

1. identify the different mobile accessing techniques.
2. Identify the different architecture of mobile communications
3. Design and develop the different configurations of LAN systems.
4. Develop different network layer and transport layer protocols.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	2	-	3	-	-	**1**	-	**1**	-	**1**	**1**	**0**	**3**
CO2	2	-	2	-	3	-	-	**1**	-	**1**	-	**1**	**1**	**0**	**3**
CO3	2	-	3	-	2	-	-	**1**	-	**1**	-	**1**	**1**	**0**	**3**
CO4	2	-	3	-	3	-	-	**1**	-	**1**	-	**1**	**1**	**0**	**3**

SUBJECT CODE: 22UEC509E	Speech Processing	Credits: 03
L:T:P –3-0-0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50

UNIT-I	10 Hrs.
Digital representation of speech signal. Waveform representation and parametric representation. Sampling rate conversion. Introduction, the process of speech production and classification and basics of phonetics, phonetic description of phonemes, the acoustic theory of speech production, digital models for speech – vocal tract, radiation, excitation the complete model.	
UNIT–II	**10 Hrs.**
Introduction, time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, voiced/unvoiced/silence detection. Pitch period estimation (Rabiner and Gold method), short time autocorrelation function, short time average magnitude difference function, u/v/speech/silence detection.	
UNIT–III	**10 Hrs.**
Introduction, definitions and properties of short time Fourier transform (STFT), Fourier transform interpretation of STFT, linear filtering interpretation of STFT, sampling of STFT, speech analysis and synthesis systems (Vocoders), phase vocoder, channel vocoder.	
UNIT–IV	**10 Hrs.**
Introduction, homomorphic transformation, frequency domain representation of homomorphic systems, inverse cepstum transformation, the complex cepstrum of speech, cepstral vocoder, processing applications of cepstral analysis.	

Reference Books *

Textbook:

1. L.R.RabinerandR.W.Schafer**,**"DigitalProcessingofSpeechSignals,"Pearson Education (Asia) Pte. Ltd., 2004.

ReferenceBook:

1. D.O'Shaughnessy,"SpeechCommunications:HumanandMachine,"UniversitiesPress, 2001.
2. B.GoldandN.Morgan,"SpeechandAudioSignalProcessing:processingand perception of speech and music' Pearson Education, 2003.

Course Outcomes**

After completion of the course student will be able to

1. Explain the speech production and perception mechanism
2. Characterize and analyze speech signals in Time domain
3. Characterize and analyze speech signals in Frequency domain
4. Analyze speech signal using homomorphic transformation and LPC

***Books to be listed as per the format with decreasing level of coverage of syllabus**

****** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	0	1	1	0	0	0	0	0	0	3	0	0
CO2	3	3	2	0	1	1	0	0	0	0	0	0	3	0	0
CO3	3	2	1	0	1	1	0	0	0	0	0	0	3	0	0
CO4	3	3	1	0	1	1	0	0	0	0	0	0	3	0	0

SUBJECT CODE:22UEC533N	Wireless Networks	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Wireless networks: Wireless network architectures, classification of wireless networks, wireless switching technology, wireless communication problems, wireless network reference model, wireless networking issues, wireless networking standards. Wireless Body Area Network (WBAN): Properties, network architecture, network components, design issues, network protocols, WBAN Technologies, WBAN Applications. Wireless Personal Area Network (WPAN): Wireless Personal Area Network, network architecture, Piconet and Scatternet, WPAN components, WPAN technologies and protocols, WPAN Applications.	
UNIT–II	**10 Hrs.**
Wireless Local Area Network (WLAN):Network components, design requirements of WLAN, network architecture, WLAN standards, WLAN protocols, IEEE 802.11p, WLAN Applications	
UNIT–III	**10 Hrs.**
Wireless Metropolitan Area Network (WMAN): Wireless Metropolitan area networks, WMAN network architecture, network protocols, broadband wireless networks, WMAN Applications. Ad-hoc Networks: Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet.	
UNIT–IV	**10 Hrs.**
MAC Protocols for Ad-hoc wireless networks: Introduction, issues in designing a MAC protocol for Ad hoc wireless networks, design goals of a MAC protocol for Ad hoc wireless networks, classification of MAC protocols, contention based protocols with reservation mechanisms. Contention-based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. Overview of ad hoc routing protocols.	

Reference Books *

1. Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks: Concepts and Protocols", Wiley-India, First Edition, 2010
2. C.SivaRamMurthy,B.S.Manoj"AdhocwirelessNetworks",PearsonEducation,2nd Edition, 2005.
3. KavehPahlavan,P.Krishnamurthy,"Principles of WirelessNetworks",Pearson Education, First Edition, 2002
4. Yi-BingLin,ImrichChlamtac,"Wireless and Mobile Network Architectures",John Wiley, First Edition, 2001
5. MarlynMallick,"Mobile and Wireless Design Essentials",Wiley, FirstEdition,2003
6. William C. Y. Lee, "Mobile Cellular Telecommunication – Analog and Digital Systems", McGraw Hill, 2ndEdition, 1995

Course Outcomes**

After completion of the course student will be able to

1. Understand the fundamentals of wireless networks
2. Analyze unique characteristics and various design issues in wireless networks
3. Demonstrate basic skills for different types of wireless networks design
4. Apply knowledge of various TCP/IP protocols for wireless networking

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	2	1	1	1	0	0	0	0	0	1	0	3
CO2	3	3	2	2	1	1	1	1	0	0	0	0	1	0	3
CO3	3	2	3	2	1	1	1	0	1	1	1	0	1	0	3
CO4	3	3	3	2	1	1	2	1	1	1	1	1	1	0	3

SUBJECT CODE: 22UEC532N	Digital Electronics and Microcontrollers	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	xx Hrs.

Combinational Logic Circuits: Definition of combinational circuit, design procedure, half adder, full adder, half subtractor, full subtractor, parallel adder, decoder, encoder, comparator (1& 2 bit), multiplexer, demultiplexer.

UNIT–II	xx Hrs.

Microprocessors and Microcontrollers: Introduction, comparison between microprocessors and microcontrollers, Z80 and 8051, 4-bit to 32-bit microcontrollers. 8051 Architecture: General features of 8051 Microcontroller, 8051 block diagram, programming model, pin description, 8051 oscillator and clock, general purpose and special function registers, internal RAM and ROM, stack, input/output pins, basics of input output port

UNIT–III	xx Hrs.

8051 Instructions and Programming: addressing modes, types of instructions, instruction set, and data move instructions, external data move instructions, arithmetic instructions, logical instructions, jump and call instructions, bit-addressable instructions, programs using all the above instructions and concepts.

UNIT–IV	xx Hrs.

Programming peripherals in assembly: Timer and counter programming (mode 1). Serial Port Programming: Basics of serial communication, 8051 serial port programming. Interrupts: 8051 interrupts, Programming timer interrupts.

Reference Books *

1. Donald D Givone, “Digital principle and design”, Tata McGraw Hill edition, 2002
2. Kenneth J. Ayala, “The 8051 Micro controller Architecture, Programming & Applications”, Penram International, 2nd Edition,1996
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, “The 8051 Micro controller and Embedded Systems”, Pearsons Education, 2nd edition, 2007. John M Yarbrough, “Digital logic applications and design”, Thomson learning, 2001.
4. Thomas L. Floyd, “Digital fundamentals”, 9th edition, PHI.
5. Dr.Uma Rao and Dr. Andhe Pallavi, “The 8051 microcontroller architecture, programming and applications”, Pearson Education, 2010.
6. David Calcutt, Fredcwon, “8051 microcontroller”, Elsevier, 1st Edition, 2004.

Course Outcomes**

After completion of the course student will be able to

1. **Proficient in defining, classifying, and analyzing combinational circuits and demonstrate the ability to design and implement various basic combinational circuits effectively.**
2. **Acquire a comprehensive understanding of microprocessors and microcontrollers and capable of analyzing the architecture and general features of the 8051 microcontroller, including its programming model, pin description, oscillator, clock, registers, and memory organization.**
3. **Develop programming skills in writing assembly programs that involve data manipulation, arithmetic operations, logical functions, jump, call instructions, and bit- addressable instructions.**
4. **Gain expertise in programming timers and counters for timekeeping and event counting, serial port communication, enabling data transmission and reception in various applications and handling interrupts for event-driven programming.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1		1	1	1							3	
CO2	3	2	1		1	1	1							3	
CO3	3	2	2		2	2	1	2	1	1	1	2		3	
CO4	3	2	2		2	1	1	2	1	1	1	2		3	

SUBJECT CODE: 2UBT522C	Environmental Studies	Credits: 01
L:T:P – 1-0-0		CIE Marks: 50
Total Hours/Week: 01		SEE Marks: 50

UNIT-I	04 Hrs.

Natural Resources: Human activities and their impacts. **Energy**: Solar energy, Wind energy, Hydropower, Tidal energy, Ocean thermal energy, Geo thermal energy, Biomass energy, Biogas, Biodiesel, Bioethanol, Hydrogen as fuel. **Non renewable Energy**: Coal, Petroleum, Natural gas, Nuclear energy.

UNIT–II	04 Hrs.

Environmental Pollution: Water pollution, water quality standards, water borne diseases, Fluoride problem, Air pollution, Noise pollution. Effect of electromagnetic waves.

Sustainable future: Concept of sustainable development, threats to sustainability, strategies for sustainable development. Environment economics – concept of green building, clean development mechanism (CDM).

UNIT–III	03 Hrs.

Current Environmental Issues of concern: 03 hours Greenhouse Effect- Greenhouse gases and Global Warming, Climate change, ozone layer depletion, Acid rain, Eutrophication, Environmental policy legislation rules & regulations

UNIT–IV	04 Hrs..

Fundamentals of Waste management: 04 hours Solid waste management: Sources, classification, characteristics, collection & transportation, disposal, and processing methods. Hazardous waste management and handling. Concept of waste water treatment, Bioremediation, Industrial waste management (Case studies: Cement, plastic, chemical, E–waste, food & construction industry waste management).

Reference Books *

1. Benny Joseph "Environmental Studies" Tata McGraw Hill, 2005
2. Dr. D. L. Manjunath, "Environmental Studies" Pearson Education, 2006
3. Koushik and Koushik "Environmental Science & Engineering" New Age International Publishers, New Delhi, 2006
4. Meenakshi "Environmental Science & Engineering" Pranticce Hall of India, 2006

Course Outcomes**

After completion of the course student will be able to

1. **Ability to recognize natural resources and its uses.**
2. **Able to understand pollution and its effects on environment and to implement sustainable future in the work place.**
3. **Ability to understand current environmental issues.**
4. **Able to apply the waste management techniques in various fields**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	-	-	-	2	3	-	-	-	-	3	1	-	-
CO2	2	-	-	-	-	-	3	-	-	-	-	3	1	-	-
CO3	-	2	-	-	-	2	2	-	-	-	-	3	1	-	-
CO4	-	-	-	1	-	2	2	1	-		-	3	1	-	1

SUBJECT CODE: 22UHS521C	**Quantitative Aptitude and Professional Skills**	**Credit: 02**
L:T:P - 2 : 0: 0		**CIE Marks: 50**
Total Hours/Week:02		**SEE Marks: 50**

Course Objectives:

1. To develop and augment written English language vocabulary and comprehension skills
2. To augment the ability to understand and analyse a problem and find its solution through analysis of data given
3. To fine-tune the quantitative analysis and problem-solving skills

UNIT-I	**08 Hrs.**
Vocabulary Development: Vocabulary Building Techniques, Root Words, Antonyms & Synonyms, Sentence Completion, Error Detection & Correction, Reading Comprehension	
UNIT–II	**08 Hrs.**
Numbers, Proportion & Finance: Number System, Factors & Multiples, The God of Math – Linear Equations, Ratio-Proportion-Variation, Percentages, Profit & Loss, Interest, Averages & Alligations	
UNIT–III	**07 Hrs.**
Time & Probability: Time & Work, Time Speed, & Distance, Permutations & Combinations, Probability	
UNIT–IV	**07 Hrs.**
Verbal, Analytical, and Visual Reasoning: Human Relations, Direction Tests, Coding Decoding, Clocks and Calendars, Visual Reasoning, Analytical Puzzles, Mathematical, Arrangement & Classification Puzzles	

Reference Books

1. R. S. Aggarwal, "A Modern Approach to Verbal and Non – Verbal Reasoning", Sultan Chand and Sons, New Delhi, 2018
2. R. S. Aggarwal, "Quantitative Aptitude", Sultan Chand and Sons, New Delhi, 2018
3. Chopra, "Verbal and Non – Verbal Reasoning", MacMillan India
4. M Tyra, "Magical Book on Quicker Maths", BSC Publications, 2018
5. George J Summers, "The Great Book of Puzzles & Teasers", Jaico Publishing House, 1989
6. Shakuntala Devi , "Puzzles to Puzzle You", Orient Paper Backs, New Delhi, 1976
7. R. S. Aggarwal, "A Modern Approach to Logical Reasoning", Sultan Chand and Sons, New Delhi, 2018
8. Cambridge Advanced Learner's Dictionary, Cambridge University Press. Kaplan's GRE guide

Course Outcomes

After active participation in this course, the student will have

CO1: Enhanced his/her vocabulary and learnt techniques to augment it further

CO2: Learned the techniques to augment his/her verbal ability

CO3: Understood step-by-analysis of the given problem and learnt to develop a method for solving it

CO4: Enhanced and augmented his/her ability to work with quantitative problems

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

VI Semester

SUBJECT CODE: 22UEC601C	Information Theory and Coding	Credits: 03
L:T:P - 3 :0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50

UNIT-I	10 Hrs.

Information theory: Introduction, measure of information, average information content of symbols in long independent sequences, average information content of symbols in long dependent sequences, Markov statistical model for information source, entropy and information rate of Markov source.
Source Coding: Properties, Shannon's encoding algorithm, Shannon-Fano encoding algorithm, Huffman Coding.

UNIT–II	10 Hrs.

Communication channels: Discrete communication channels, entropy functions and equivocation, mutual information, properties of mutual information, rate of information transmission over a discrete channel, capacity of a discrete memory less channel, Shannon's theorem on channel capacity, channel efficiency and redundancy, symmetric/uniform channel, binary symmetric channel, binary erasure channel. Shannon-Hartley law and its implications.

UNIT–III	10 Hrs.

Error control coding: Introduction, types of errors, examples of error control coding, methods for controlling errors, types of codes. **Linear Block Codes:** Matrix description of LBC, encoding circuit for (n, k) linear block codes, syndrome and error correction, syndrome calculation circuit, Hamming weight, Hamming distance and minimum distance of LBC, error detection and correction capability of LBCs, standard array.

UNIT–IV	10 Hrs.

Binary Cyclic Codes: Algebraic structure of cyclic codes, encoding using (n, k) bit shift register, syndrome calculation, error detection and correction.
Convolution codes: Connection pictorial representation, time and transform domain approach, systematic convolution codes, **Structural properties of convolution codes:** State diagram, code tree, trellis diagram.

Experiments

Sl.No	Experiment Name
1.	Compute the information content and entropy of a given discrete memory-less source
2.	Determination of various entropies and mutual information of a given Binary Symmetric Channel
3.	Generation and evaluation of variable length source coding (Shannon – Fano coding)
4.	Generation and evaluation of variable length source coding (Huffman coding)
5.	Systematic encoding of a linear block code using a given generator matrix.
6.	Detection and correction of error in a received codeword in linear block code.
7.	Systematic and non-systematic encoding for a cyclic code
8.	Implement systematic decoding of cyclic code
9.	Implement convolutional coding using the transform domain approach

10.	Implement convolutional coding using the time domain approach

Reference Books *

1. P.S. Satyanarayana,2004, Concepts of information theory and coding (2nd edition)Dynaram**.**
2. Bernard Sklar,2002, Digital communication fundamentals and applications (2nd edition) Pearson education.
3. K. Sam Shanmugam, 1996, Digital and analog communication systems**,** John Wiley.
4. Simon Haykin,2003, Digital communication**,** John Wiley.

Course Outcomes**

After completion of the course student will be able to

1. Demonstrate the basic information theory concepts, entropy, need of coding and working of
2. different types of source coding techniques.
3. Derive channel capacity expression for different types of discrete communication channels and describe entropy functions, equivocation, mutual information of communication channel.
4. Design an encoder, decoder, and error correction circuit for linear block code.
5. Design an encoder, decoder and error correction circuit for cyclic code and demonstrate encoding of convolutional codes, also verify its structural properties using code tree and trellis diagram.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	0	1	1	1	0	0	0	0	0	3	0	0
CO2	3	2	1	0	0	1	0	0	0	0	0	0	3	0	0
CO3	3	3	2	0	1	1	1	0	0	0	0	0	3	0	0
CO4	3	3	2	0	1	1	1	0	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC602C	Electromagnetic Theory	Credits: 03
L:T:P - 2 : 2 : 0		CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

UNIT-I	10 Hrs.
Coulomb's Law and electric field intensity: Introduction to coulomb's law, field intensity,field due to continuous volume charge distribution, Field of a line charge & field of sheet charge, Electric flux density Gauss law and divergence: Electric flux density, Gauss law, Application of Gauss law for symmetrical charge distribution (point charge, Coaxial cable)and differential volume element, Divergence, Maxwell's first equation, vector operator delland divergence theorem.	
UNIT–II	**10 Hrs.**
Energy and potential: Energy expended in moving a point charge in an electric field, the line integral, definition of potential difference and potential, the potential field of a point charge, potential field of system of charges, potential gradient, Energy density in an Electrostatic Field. Conductors, dielectrics and capacitance: Current and current density, continuity of current, conductor properties and boundary conditions, boundary conditions for perfect dielectrics, capacitance and examples (Parallel plate capacitor, Dielectric boundary normal to plates).	
UNIT–III	**10 Hrs.**
Poisson's and Laplace's equations: Poisson's and Laplace's equations. Uniqueness theorem, examples of the solution of Lapalce and poisson's equations. The steddy Magnetic Field:Biot-savart's law, Ampere's Circuital Law, curl, stokes theorem, magnetic flux density, scalar and vector magnetic potentials.	
UNIT–IV	**10 Hrs.**
Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's equation in point and integral form, retarded potentials. Uniform Plane Wave: Wave Propagation In free space an Dielectrics, Poynting's Theorem and wave power, Plane wave in boundaries and in dispersive media: Reflection Uniform Plane Wave At normal incidence, SWR.	

Reference Books *

1. WilliamHHaytJr,JohnABuck,"EngineeringElectronics",TataMcGraw-Hill,7th edition, 2006
2. JohnKraussandDanielAFleisch,"Electromangeticswithapplication",McGraw- Hill, 5th edition, 1999
3. DavidKCheng,"FiledandwaveElectromangetics"PearsoneducationAsia,2nd edition,-1989, Indian Reprint-2001.

Course Outcomes**

After completion of the course student will be able to

1. Understand the concept of scalar, vectors, Coulombs law, Electric filed intensity,Gauss law and its applications, divergence and analyze the problems based on the mentioned laws
2. Understand potential due to charges, potential gradient, continuity equation, boundary conditions and capacitance and Analyze the problems based on the mentioned laws
3. Understand Poisson's, Laplaces equation and its application, Uniqueness theorem, Biot-savart's law, ampere's law, stokes theorem and Curl with respect to magnetic fields and analyze the problems related to the mentioned laws
4. Understand about time varying fields, Maxwell's equation, retarded potential, wave propagation in free space, Poynting's theorem, uniform plane waves, Polarization of plane waves, Standing Wave Ratio (SWR) and analyze the problems based on the mentioned laws.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	2	2	1	0	0	0	0	3	0	0
CO2	3	2	3	2	1	2	2	1	0	0	0	0	3	0	0
CO3	3	2	3	2	2	2	2	1	0	0	0	0	3	0	0
CO4	3	3	3	3	3	3	3	1	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC603C	CMOS Digital VLSI Design	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning. **MOS Transistor Theory:** Introduction, Long- Channel I-V Characteristics, C-V Characteristics (simple MOS capacitance models), Non ideal I-V Effects, DC Transfer Characteristics. **CMOS Processing Technology:** Introduction, CMOS Technologies.	
UNIT–II	**10 Hrs.**
Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model (Logical effort, parasitic delay, delay in logic gate, drive), Logical Effort of Paths, **Power:** Introduction, Dynamic Power, Static Power.	
UNIT–III	**10 Hrs.**
Interconnect: Introduction (wire Geometry), Interconnect Modeling, Interconnect Impact (Delay, Energy, Cross talk). **Combinational Circuit Design:** Introduction, Circuit families, Silicon-On-Insulator Circuit Design.	
UNIT–IV	**10 Hrs.**
Sequential Circuit Design: Introduction, Circuit Design of Latches and Flip Flops (conventional CMOS latches, conventional CMOS flip flops, pulsed latches, resettable latches and flip flops, enabled latches and flip flops, incorporating logic into latches, dual edge triggered flip flops. **Array Subsystems:** Introduction, SRAM (SRAM cells, ROW circuitry, column circuitry), Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays.	

Reference Books *

Text Book:

1. Neil H. E. Weste, David Harris "CMOS VLSI Design A Circuits and Systems Perspective"
2. Pearson Education Publisher, Fourth Edition, 2015.

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic "Digital Integrated Circuits A Design
2. Perspective" Pearson Education Publisher, Second Edition. 2010.
3. John P Uyemura "Introduction to VLSI Circuits and Systems" Wiley Publication 2002.
4. R. Jcob Baker, Harry W. Li and David E Boyce "CMOS Circuit Design, Layout, and Simulation"

Course Outcomes**

After completion of the course student will be able to

1. Draw the layout of CMOS circuits; apply the knowledge of fabrication processes and MOSFET transistors in VLSI design.
2. Draw RC equivalent circuit of CMOS circuits and estimate delay and power.
3. Model & design of interconnects in chips, design of combinational circuits.

4. Design basic buildings of sequential and memory blocks using MOSFET transistors.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	0	0	0	0	0	0	0	0	0	3	1	0
CO2	3	3	3	0	0	0	0	0	0	0	0	0	3	2	0
CO3	3	3	3	0	0	0	0	0	0	0	0	0	3	2	0
CO4	3	3	3	0	0	1	2	0	0	0	0	0	3	2	0

SUBJECT CODE: 22UEC618L	CMOS Digital VLSI Laboratory	Credits: 01
L:T:P – 0-0-3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

NAME OF THE EXPERIMENT
Design following CMOS/TG based circuits with given specifications* and complete the VLSI design flow mentioned below using appropriate tool: a) Draw the schematic and verify the following i) DC Analysis ii)Transient Analysis b) Draw the Layout and verify the DRC,ERC c) Check for LVS d) Extract RC and back annotate the same and verify the design. 1) CMOS inverter 2) CMOS two input NAND gate 3) CMOS two input NOR gate 4) CMOS two input OR gate 5) CMOS two input AND gate 6) TG based two input XOR and XNOR gates 7) Negative edge triggers D flip flop using TGs and inverters 8) 4:1 MUX using TGs and inverters 9) 3- Bit up counter 10) 3-Bit SISO shift register **An appropriate constraint should be given*
Course Outcomes**
After completion of the course student will be able to **1. Design CMOS/ TG based gates, MUX, flipflops, counters and shift register.** **2. Draw the layout, run DC and transient analysis for designed CMOS standard cells.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	0	2	0	3	0	0	0	0	0	0	0	3	0	0
CO2	1	0	2	0	3	0	0	0	0	0	0	0	3	0	0

SUBJECT CODE: 22UEC619L	Computer Networks Laboratory	Credits: 01
L:T:P - 0 : 0 : 2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

Sl.No.	LISTOF EXPERIMENTS
1.	Study of different types of network cables and practically implement the cross-wired cable and straight through cable using clamping tool
2.	Study of network components/devices:i)NICii)Hubiii)Switch
3.	Connecting computers on Local Area Network(LAN)
4.	Study of packet tracer
5.	Configuration of different network topologies using packet tracer
6.	Configuration of switch and establishing LAN using packet tracer
7.	Creation of Virtual LAN(VLAN)using packet tracer
8.	Configuration Of Basic Routing Using Packet Tracer
9.	Configuration of a network using Routing Information Protocol(RIP)using packet tracer
10.	Configuration of a network using Open Shortest path First(OSPF)using packet tracer
11.	Configuration of DHCP using packet tracer
12.	Configuration of NAT using CISCO packet tracer

Course Outcomes**

After completion of the course student will be able to

1. To Apply the concepts of Data Communication and Networking
2. To do Internetworking & devices
3. To Develop New Routing techniques
4. Practically Know The Functionality of devices using RIP, OSPF, DHCP,and NAT

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	2	1	1	1	0	0	0	0	0	1	0	3
CO2	3	3	2	2	1	1	1	1	0	0	0	0	1	0	3
CO3	3	2	3	2	1	1	1	0	1	1	1	0	1	0	3
CO4	3	3	3	2	1	1	2	1	1	1	1	1	1	0	3

SUBJECT CODE: 22UEC615C	JAVA Programming	Credits:03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	xx Hrs.

Introducing classes, Objects and Methods: Introducing Classes, Class Fundamentals, The GeneralForm of a Class, A Simple Class, Declaring Objects, A Closer Look at new, Assigning Object Reference Variables, Introducing Methods, Adding a Method to the Box Class, Returning a Value, Adding a Method That Takes Parameter , Constructors, Parameterized Constructors, The this Keyword, The finalize( ) Method, A Stack Class. A Closer Look at Methods and Classes : Overloading Methods , Overloading Constructors, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited, Introducing Nested and Inner Classes, Exploring the String Class, Using Command Line Arguments.

UNIT–II	xx Hrs.

Inheritance: Inheritance, Inheritance Basics, Member Access and Inheritance, Example, A Super class Variable Can Reference a Subclass Object, Using super, Using super to Call Super class Constructors, A Second Use for super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Why Overridden Methods?, Applying Method Overriding. Using Abstract Classes, Using final with Inheritance, Using final to Prevent Overriding, Using final to Prevent Inheritance, The Object Class. Packages and Interfaces: Packages, Defining a Package, Finding Packages and CLASS PATH, A Short Package Example, Access Protection, An Access Example, Importing Packages, Interfaces, Defining an Interface, Implementing Interfaces, Nested Interfaces.

UNIT–III	xx Hrs.

Exception Handling : Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Displaying a Description of an Exception, Multiple catch Clauses , Nested try Statements, throw, throws, finally, Java's Built-in Exceptions , Creating Your Own Exception Subclasses, Using Exceptions . Multithreaded Programming : The Java Thread Model, Thread Priorities, Synchronization, Messaging, The Thread Class and the Runnable Interface, The Main Thread, Creating a Thread, Implementing Runnable, Extending Thread, Creating Multiple Threads, Using is Alive( ) and join( ).

UNIT–IV	xx Hrs.

Multithreaded Programming Continuous: Thread Priorities, Inter thread Communication, Deadlock, Suspending, Resuming, and Stopping Threads, Suspending, Resuming, and Stopping Threads. The Applet Class :Two Types of Applets, Applet Basics, The Applet Class, Applet Architecture, An Applet Skeleton, Applet Initialization and Termination, Overriding update( ), Simple Applet Display Methods, A Simple Banner Applet, Using the Status Window, The HTML APPLET Tag, Passing Parameters to Applets, get Document Base( ) and get Code Base( ), Applet Context and show Document( ), The Applet Stub Interface .

Reference Books *

1. From Complete Reference, "The Complete Reference" 7th edition
2. E. Balagururusamy, "Program with JAVA" 4th edition
3. Herbert Schildt, Dale Skrien, "Java Fundamentals A Comprehensive Introduction" McGraw Hill
4. The JAVA tutorials, 4th Edition by SUN Microsystems

Course Outcomes**
After completion of the course student will be able to **1. Use fundamentals of class, objects, methods, operators, constructors.** **2. Write programs using Inheritance, Super class, methods overriding, object class, final key,packages & interfaces in java code.** **3. Handling Exceptions fundamentals, exception hierarchy, exception JAVA Programming fundamentals & Multithreaded Programming concepts.** **4. Establish Inter thread communication, set thread priorities, solve deadlock , operations of suspend(),resume(), Stop(). Programming for applets.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	0	0	0	2	1	0	0	0	0	1	2	0	2
CO2	3	2	0	0	0	1	1	0	0	0	0	2	2	0	2
CO3	3	3	0	0	0	1	1	0	0	0	0	3	2	0	2
CO4	3	2		0	0	1	2	0	0	0	0	3	2	0	2

SUBJECT CODE: 22UEC616E	Micro Electro Mechanical Systems	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to MEMS Technology: Basic definitions, history and evolution of MEMS. Feynman's vision, microelectronics and MEMS, microsensors, microactuators and microsystems, Types of MEMS, Applications of MEMS in various disciplines. Commercial MEMS products.
Multiphysics-Multiengineering aspects of MEMS: Introduction to design, modeling and simulation, optimization, fabrication, reliability and packaging of MEMS.
Scaling issues in microsystems, examples and numerical problems based on scaling laws.

UNIT–II	10 Hrs.

Design and Working Principles of MEMS: Transduction principles in microdomain- Biomedical sensor & biosensor and DNA sensor, chemical sensor, optical sensor, pressure sensor, thermal sensor. Actuation using thermal force, shape-memory alloy, piezoelectric and electrostatic forces.Mechanical sensors and actuators – beams and cantilevers, accelerometers. Electrostatic sensors and actuators – parallel plate capacitors, comb drive sensor and actuator. Optical MEMS – DLP mirror; construction and working.

UNIT–III	10 Hrs.

Modeling and Simulation of MEMS: Basic modeling elements in mechanical systems, electrical systems, microfluidic systems, thermal systems, magnetic domain and electrostatic systems. Measurement tools in microsystems: AFM, SEM and optical inferometry. Characterization methods. Simulation of MEMS: Need for simulation, FEM, MEMS design and realization tools – ANSYS/Multiphysics, CoventorWare, COMSOL. AFM as a measurement tool in microsystems. Case Studies: Microcantilever based sensor, electrothermal actuator, electrostatic actuator.

UNIT–IV	10 Hrs.

Microfabrication/Micromachining: Overview of micro fabrication, silicon wafer extraction and cleaning, structural and sacrificial materials in microfabrication, lithography, deposition, doping, etching, Introduction to MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods.

Reference Books *

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan, K. N. Bhat, V. K. Atre, "Micro and smart systems", Wiley, India, 2010.
2. N. P. Mahalik, "M EMS", Tata McGraw-Hill, 2007.
3. Tai, Ran Hsu,"MEMS and microsystems: design and manufacture", TMH, 2002.
4. James J. Allen, "Micro Electro Mechanical System design", CRC Press, Taylor & Francis Group, 2005.
5. Chang Liu, "Foundations of MEMS", Pearson education international, 2007.
   Stephen D. Senturia, "Microsystem design", Springer International edition, 2001.

Course Outcomes**

After completion of the course student will be able to

1. **Comprehend the fundamentals of MEMS and expose students to the basic scaling laws as applied to micro domain.**
2. **Design and understand the working principle of various microsensing and actuating devices.**
3. **Mathematically model and simulate the various types of micro-systems**
4. **Comprehend the various steps involved in microfabrication and micromachining of micro devices, structures and systems.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	1	1	0	0	1	0	0	0	2	0	3	3	0
CO2	3	3	3	3	0	0	2	0	0	0	3	0	3	3	0
CO3	3	2	2	2	3	0	0	0	0	0	3	0	3	3	1
CO4	3	2	2	3	0	0	0	0	0	0	3	0	3	3	0

SUBJECT CODE: 22UEC607E	Computer Organization	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Performance–Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement, Historical Perspective. **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing. Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.	
UNIT–II	**10 Hrs.**
Input/Output Organization: Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Interface Circuits, Standard I/O Interfaces–PCI Bus and USB.	
UNIT–III	**10 Hrs.**
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size and Cost, Cache Memories–Mapping Functions, Replacement Algorithms, Performance Considerations, Virtual Memories, Secondary Storage. **Arithmetic:** Addition And Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers	
UNIT–IV	**10 Hrs.**
Arithmetic Cont.: Signed, Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations. **Basic Processing Unit:** Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control and Microprogrammed Control.	

Reference Books *

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, “Computer Organization”, Tata McGraw Hill, 5th Edition, 2002
2. David A. Patterson, John L. Hennessy, “Computer Organization and Design – The Hardware /Software Interface ARM Edition”, Elsevier, 4th Edition, 2009
3. WilliamStallings,“ComputerOrganization&Architecture”,PHI,7thEdition,2006

Course Outcomes**

After completion of the course student will be able to

1. Have thorough knowledge about structure and performance of a modern digital computer.
2. Analyze the different ways of communicating with I/O devices and standard I/O interfaces in a compute including using interrupt.
3. Analyze memory hierarchy including main memory, cache memory, virtual memory and secondary memory considering cost/performance. Different Mapping Functions of cache.
4. Implement arithmetic operations like multiplication, division and analyze the process of instruction execution of a complete instruction in the processing unit and its control.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	2	1	2	0	0	0	0	0	0	0	0	0	2
CO2	1	1	2	1	3	0	0	0	0	0	0	0	0	0	3
CO3	1	1	2	1	2	0	0	0	0	0	0	0	0	0	2
CO4	1	1	3	1	3	0	0	0	0	0	0	0	0	0	3

SUBJECT CODE: 22UEC615E	Embedded System	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Introduction to embedded systems, embedded system vs. general computing system, classifications, purpose of embedded system, major application areas including some novel applications. The typical embedded system: Core of embedded system, memory, sensors and actuators, communication interface, Characteristics and quality attributes of embedded systems.	
UNIT–II	**10 Hrs.**
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, architecture of ARM Cortex M3, various units in the architecture, debugging support, general purpose registers, special registers, exceptions, interrupts, stack operation, reset sequence.	
UNIT–III	**10 Hrs.**
Hardware software co-design and program modeling: fundamental issues in hardware software co-design, computational models in embedded system, hardware software trade-offs. Embedded firmware design and development: design approaches, Mixing assembly and high level language, Programming in embedded C.	
UNIT–IV	**10 Hrs.**
Real-time operating system based embedded system: operating system basics, need for RTOS, types of operating system, tasks, process and threads, multiprocessing and multitasking, task scheduling, threads, processes and scheduling : putting altogether, task communication, task synchronization, device drivers.	

Reference Books *

1. Shibu K V, "Introduction to embedded systems", Tata McGraw Hill private limited, 2010.
2. Joseph Yiu, "The definitive guide to the ARM CORTEX-M3", Newnes, Second edition.
3. Rajkamal, "Embedded systems: architecture, programming and design", Tata McGraw Hill private limited, second edition.
4. Frank Vahid, Tony Givargis, "Embedded system design: A unified hardware/software introduction", John Wiley and Sons, 2001.

Course Outcomes**

After completion of the course student will be able to

1. **Gain comprehensive knowledge about embedded systems, major application area of embedded systems and system components like memory, sensors and actuators.**
2. **Gain comprehensive knowledge about ARM-32 bit Microcontroller, architecture and other internal details.**
3. **Develop embedded applications on IDE environment and programming in embedded 'C'.**
4. **Explore one opensource RTOS and demonstrate the basic concepts of RTOS.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1	0	1	1	0	0	0	0	0	0	0	3	0
CO2	3	2	2	0	1	1	0	0	0	0	0	0	0	3	0
CO3	3	3	3	0	3	3	0	0	0	0	0	0	0	3	0
CO4	3	3	3	0	3	2	0	0	0	0	0	0	0	3	0

SUBJECT CODE : 22UEC617E	Digital Verification	Credits: 02
L:T:P – 2-0-0		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

UNIT-I	07 Hrs.

Verification Guidelines: The Verification Process, The Verification Methodology Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, What Should You Randomize, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance.
Procedural Statements and Routines: Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.
Connecting the Testbench and design: Separating the Testbench and Design, The Interface Construct, Stimulus Timing, Interface Driving and Sampling, Program Block Considerations, Connecting It All Together, Top-Level Scope, Program–Module Interactions, SystemVerilog Assertions, The Ref Port Direction.

UNIT–II	07 Hrs.

Basic OOP: Introduction, Think of Nouns, not Verbs, Your First Class, Where to Define a Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Class Methods, Defining Methods Outside of the Class, Static Variables vs. Global Variables, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Local, Straying Off Course Building a Testbench.
Randomization: Introduction, What to Randomize, Randomization in SystemVerilog, Constraint Details, Solution Probabilities, Controlling Multiple Constraint Blocks, Valid Constraints, In-Line Constraints, The pre_randomize and post_randomize Functions, Random Number Functions, Constraints Tips and Techniques, Common Randomization Problems, Iterative and Array Constraints, Atomic Stimulus Generation vs. Scenario Generation, Random Control, Random Number Generators, Random Device Configuration.
Threads and Interprocess communication: Working with Threads, Disabling Threads, Interprocess Communication, Events, Semaphores, Mailboxes, Building a Testbench with Threads and IPC, Basic Transactor, environment class.

UNIT–III	07 Hrs.

UVM Introduction: A Conventional Testbench for the TinyALU, SystemVerilog Interfaces and Bus Functional Models, Static Methods and Variables, Parameterized Class Definitions,The Factory Pattern,An Object-Oriented Testbench, UVM Tests, UVM Components,UVM Environments, A New Paradigm, Talking to Multiple Objects

UNIT–IV	07 Hrs.

UVM Contd..: Using Analysis Ports in a Testbench, Interthread Communication, Put and Get Ports in Action, UVM Reporting, Class Hierarchies and Deep Operations, UVM Transactions, UVM Agents,UVM Sequences, onward with the UVM.

Reference Books *

1. Chris Spear and Greg Tumbush "SystemVerilog for Verification: A Guide to Learning the Testbench Language Features" Third Edition, Springer, 2012
2. Ray Salemi "The UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology"Boston Light Press; First Edition, 2013
3. Donald Thomas "Logic Design and Verification Using Systemverilog" Createspace Independent

Pub, 2016

4. Mark A. Azadpour "SystemVerilog for Design and Verification using UVM" 2015
   Ashok B. Mehta "ASIC/SoC Functional Design Verification: A Comprehensive Guide to Technologies and Methodologies" Springer, 2017

Course Outcomes**

After completion of the course student will be able to

1. **Appreciate the importance and scope of digital verification and UVM.**
2. **Write testbench using SystemVerilog and OOPs concept.**
3. **Write testbench using on SystemVerilog and UVM.**
4. **Write automated testbench using SystemVerilogand UVM.**

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	0	1	2	3	0	0	0	0	0	0	0	0	3	0
CO2	1	0	1	2	3	0	0	0	0	0	0	0	0	3	0
CO3	1	0	1	2	3	0	0	0	0	0	0	0	0	3	0
CO4	1	0	1	2	3	0	0	0	0	0	0	0	0	3	0

SUBJECT CODE: Open Elective	Fiber Optics and Network	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

This course will enable students to learn:

1. The fundamental principles of optical fiber communication, including different modes of light propagation, transmission characteristics, and the factors contributing to losses in optical fibers.
2. Optical sources and detectors, their characteristics, fiber connectors, and the various techniques used for splicing fibers.
3. The operation and configuration of receivers, as well as various techniques for coherent transmission and the factors affecting system performance in optical communication systems.
4. Optical network components and the infrastructure of SONET/SDH (Synchronous Optical Network/Synchronous Digital Hierarchy).

UNIT-I	xx Hrs.
Overview of optical fiber communication: Optical Spectral Bands, Basic Principles, Fiber Modes and Configuration, Step-index and Graded index structures, Fiber Materials, Fiber Fabrication**.** **Signal degradation in optical fibers:** Attenuation, Signal Distortion in Optical Waveguides, Characteristics of Single Mode Fibers.	
UNIT–II	**xx Hrs.**
Optical sources: Characteristics of Light Sources for Communication, LED and LASER diode sources. **Power launching and coupling:** Source to Fiber Power Launching, Lensing Schemes for Coupling Improvement, Fiber-to-Fiber joints, LED Coupling to Single Mode Fibers, Fiber Splicing, Optical Fiber Connectors. **Photo detectors:** Physical Principles of Photo Diodes, PIN Photodiode, Avalanche Photo Diode	
UNIT–III	**xx Hrs.**
Optical receiver operation: Fundamental Receiver Operation, Digital Receiver Performance Calculation, Analog Receivers. Digital links: Point-to-Point Links, Power Penalties. Analog Links: Overview of Analog Links, Carrier –to-Noise Ratio, Multichannel Transmission Techniques, RF over Fiber, Radio –over –Fiber Links	
UNIT–IV	**xx Hrs.**
Optical Network Components: Principle and Operation of couplers, Isolators, Circulators, Fabry Perot Filters, Mach-Zehnder Interferometer & EDFA. Optical Networks : Client layers of SONET/SDH, SONET/SDH layers, SONET/SDH frame structure, SONET/SDH physical layer, Elements of SONET/SDH infrastructure,	

Reference Books *

1) Gerd Keiser, "Optical Fiber Communications", MGH, 4th Edition, 2008
2) John M. Senior, "Optical Fiber Communications", Pearson, 2nd Edition, 2006
3) Rajiv Ramaswami, Kumar N Sivarajan "Optical Networks", Elsevier, 2nd Edition, 2004

Course Outcomes**

A student who successfully completes this course should be able to

1. Demonstrate an understanding of different modes of light propagation, transmission characteristics, and the factors contributing to losses in optical fibers.
2. Characterize optical sources, detectors, connectors, and various fiber splicing techniques, with a clear understanding of their roles in optical communication systems.

3. Explain the operation and configuration of receivers, evaluate coherent transmission techniques, and assess performance factors impacting optical communication systems.
4. Describe optical networking and SONET/SDH infrastructure, including the components and operation of SONET/SDH systems for efficient data transmission.

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1: Demonstrate an understanding of different modes of light propagation, transmission characteristics, and the factors contributing to losses in optical fibers.	3	3	2	2	1	1	1	0	0	0	0	0	3	0	0
CO2: Characterize optical sources, detectors, connectors, and various fiber splicing techniques, with a clear understanding of their roles in optical communication systems	3	2	2	2	1	1	1	0	0	0	0	0	3	0	0
CO3: 3. Explain the operation and configuration of receivers, evaluate coherent transmission techniques, and assess performance factors impacting optical communication systems**.**	3	3	2	2	1	1	1	0	0	0	0	0	3	0	0
CO4: 4. Describe optical networking and SONET/SDH infrastructure, including the components and operation of SONET/SDH systems for efficient data transmission	3	3	3	2	2	1	2	0	0	0	0	0	3	0	0

SUBJECT CODE: Open Elective	Sensor Technology	Credits: 03
L:T:P – 3-0-0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	xx Hrs.

Sensor Fundamentals: Introduction, Definition, Types, and Sensor Characteristics
Principles of Sensing: Capacitive, Magnetic, Inductive, Resistive, Piezoelectric, Piezoresistance, Pyroelectric, Hall effect.
I**nterfacing Electronic Circuits:** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, A to D Converters, Bridge Circuits, Data Transmitters, Batteries for low power sensors

UNIT–II	xx Hrs.

Overview of Sensor Materials: Sensor materials and material properties, Surface Processing of materials for development of Sensors.
Sensor Technologies: Micro technology**,** Micro-Electro-Mechanical Systems Technology, Nanotechnology
Sensor Applications: Displacement Sensing, level & Velocity Sensors, Accelerometers, Tactile Sensors, Pressure Sensors, Temperature Sensors, Comb drive Sensors.

UNIT–III	xx Hrs.

Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.
Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature,
Capacitive sensors: Stretched diaphragm type: microphone, response characteristics. Piezoelectric element: piezoelectric effect
Case Study: Piezoelectric and Capacitive Pressure Sensors, Cantilever based DNA Sensor, CNT based Pressure Sensor.

UNIT–IV	xx Hrs.

Interfacing: Communication Basics, parallel, serial and wireless communication, Basic protocol concept, communication protocols, USB interface, Processor interfacing basics, Controller and computer based control implementations. Introduction to wireless sensor network and wireless network protocols

Reference Books *

1. Jacob Fraden, “Handbook of Modern Sensors: Physical Design & Applications”, AIP Press, Springer.
2. D. Patranabis, “Sensors & Transducers”, PHI Publication New Delhi.
3. Frank Vahid, Tony Givargis, “Embedded system Design”,JohnWieley& Sons, Inc, 2002
4. H.K.P. Neubert, “Instrument transducers”, Oxford University press.
5. E.A. Doebelin, “Measurement systems: application & design”, Mc Graw Hill

Course Outcomes**

After completion of the course student will be able to

5. Use concepts for converting a physical parameter into an electrical quantity
6. Identify appropriate sensor materials and technology while designing sensors
7. Comprehend working principle of mechanical, strain gauge and capacitive sensors.

8.	Set up sensor data acquisition and communication strategies
9.	Suggest sensor performance improvement methodologies

* **Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**			**2**		**2**				**2**	**3**	**1**	
CO2	**3**	**1**	**2**			**3**			**2**			**3**	**3**	**2**	
CO3	**3**	**3**	**3**		**2**	**2**				**1**		**2**	**3**	**2**	
CO4	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**		**1**	**2**	**3**	**3**	**3**	

SUBJECT CODE: Open Elective	Image Processing (Department Open Elective)	Credits: 03
L:T:P - 3: 0: 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50

Course Objectives:

1. To provide the basic knowledge on image processing concepts.
2. To develop the ability to apprehend and implement various image processing algorithms.
3. To understand various image processing steps and their applications in real time
4. To facilitate the students to comprehend the contextual need pertaining to various image processing applications.

UNIT-I	10 Hrs.

Introduction- Digital Image, its Representation & point operations: Image Representation and Image Processing Paradigm - Elements of digital image processing, Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels, Color image (overview, various color models)-Various image formats bmp, jpeg, tiff, png, gif, etc. Noise in Images Sources, types. Arithmetic operations, Logical operations, Spatial operations Single pixel, neighbour hood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms.

UNIT– II	10 Hrs.

Image Enhancement: Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothening spatial filters, Sharpening spatial filters; Frequency filtering-Smoothening frequency filters-Sharpening frequency filters, Selective filtering.

Image Restoration: Noise models - Degradation models-Methods to estimate the degradation-Image deblurring Restoration in the presence of noise only spatial filtering-Periodic noise reduction by frequency domain filtering-Inverse filtering-Wiener Filtering.

UNIT– III	10 Hrs.

Feature Extraction: Region of interest (ROI) selection - Feature extraction: Histogram based features - Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation-Texture descriptors.

Image Segmentation: Discontinuity detection-Edge linking and boundary detection. Thresholding-Region oriented segmentation- Histogram based segmentation. Object recognition based on shape descriptors.

UNIT– IV	10 Hrs.

Image Coding and Compression: Lossless compression versus lossy compression-Measures of the

compression efficiency- Huffmann coding, Bit plane coding, Arithmetic coding. Wavelet Transform in image processing: Wavelet Transform in one dimensions, Wavelet transforms in two dimensions. Fast Wavelet Transform , Other Applications of Wavelet in image processing.

Reference Books *

Author/s last Name, initial (Year), Book Title (edition), Publisher

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Edition, Pearson, 2018.
2. William
2. K. Pratt, Digital Image Processing, 4th Edition, John Wiley, 2007.
3. Fundamentals of Digital Image Processing, Jain A.K., PHI, 1997
4. Insight into wavelets - From theory to practice, K. P. Soman and K. I. Ramchandran, PHI ,2005, Second Edition.
5. Rafael C. Gonzalez, "Digital Image processing using MATLAB", Richard E. Woods and Steven Low price Edition, Pearson Education Asia, India, 2nd Edition, 2004.

Course Outcomes**

After completion of the course student will be able to

1. Ascertain and describe the basics of image processing concepts through mathematical interpretation and operations.
2. Acquire the knowledge of various image enhancement techniques involved.
3. Demonstrate image restoration process and its respective filters required.
4. Experiment the various image segmentation and feature extraction operations.
5. Design the various image coding and compression procedures and illustrate the wavelet transform in images with its applications.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

Course Articulation Matrix

Course Outcomes	**Programme Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	1	0	1	1	1	0	1	3	0	0
CO2	3	3	3	2	2	1	0	1	1	1	0	1	3	0	0
CO3	3	3	3	2	2	1	0	1	1	1	0	1	3	0	0
CO4	3	3	3	2	2	1	0	1	1	1	0	1	3	0	0
CO5	3	3	3	2	2	1	0	1	1	1	0	1	3	0	0

Assignment:

Students are required to develop programs
using Matlab. List of Programs

1. Write program to read and display digital image using MATLAB or SCILAB
    a. Become familiar with SCILAB/MATLAB Basic commands
    b. Read and display image in SCILAB/MATLAB
    c. Resize given image
    d. Convert given colour image into gray-scale image
    e. Convert given colour/gray-scale image into black & white image
    f. Draw image profile
    g. Separate colour image in three R G & B planes
    h. Create colour image using R, G and B three separate planes
    i. Write given 2-D data in image file
2. To write and execute image processing programs using point processing method
    a. Obtain Negative image
    b. Obtain Flip image
    c. Thresholding
    d. Contrast stretching
3. To write and execute programs for image arithmetic operations
    a. Addition of two images
    b. Subtract one image from other image
    c. Calculate mean value of image
    d. Different Brightness by changing mean value
4. To write and execute programs for image logical operations
    a. AND operation between two images
    b. OR operation between two images
    c. Calculate intersection of two images
    d. Water Marking using EX-OR operation
    e. NOT operation (Negative image)
5. To write a program for histogram calculation and equalization using
    a. Standard MATLAB function
    b. Program without using standard MATLAB functions
6. To write and execute program for geometric transformation of image
    a. Translation b. Scaling c. Rotation d. Shrinking e. Zooming
7. To understand various image noise models and to write programs for
    a. image restoration b. Remove Salt and Pepper Noise c. Minimize Gaussian noise d. Median filter and Weiner filter
8. Write a program in MATLAB/SCILAB for edge detection using different edge detection mask
9. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

21UHS600C	**Indian Knowledge Systems** (Common to All Branches)	**Credit:01**
Hrs/Week: 1:0:0		**CIE Marks:**50
Total Hours: 15Hrs		**SEE Marks:**50

Course Objectives:

1. To provide a general introduction to Indian Knowledge System (IKS)
2. To sensitize the students to the contributions made by ancient Indians in the field of Science, Philosophy and related applications and concepts.

UNIT - I	**3Hrs**
Indian Knowledge Systems (IKS) Overview, Vedic Corpus, Philosophy, Character, scope and importance, traditional knowledge vis-a-vis Indigenous knowledge, traditional knowledge vs. western knowledge.	
UNIT – II	**4Hrs**
Traditional Knowledge in Mathematics and Humanities Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contribution. Number Systems and Units of Measurement. Linguistics, Art, Craft and Trade in India, Number Systems and Units of Measurement	
UNIT - III	**4Hrs**
Traditional Knowledge in Physics and Chemistry Measurements for time, distance and weight, Astronomy, Indian contributions in astronomy, Astrology, The celestial coordinate system, Elements of the Indian calendar, Notion of years and month, Panchanga – The Indian calendar system, Metals and Metalworking: The rise and fall of a great Indian technology, Mining and ore extraction, Zinc extraction, Copper and it's alloys, Iron and steel in ancient India	
UNIT - IV	**4Hrs**
Traditional Knowledge in Professional domain Town Planning and Architecture, Agriculture, Governance and Public Administration, United Nations Sustainable development goals	

Reference books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi (2022**).** Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Sampad and Vijay "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry. (2011).
3. Acarya, P.K. Indian Architecture, Munshiram Manoharlal Publishers, New Delhi. (1996).
4. Kapoor Kapil, Singh Avadhesh "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P. (2021).
5. Dasgupta,S. A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi. (1975).
6. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

Suggested Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
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 Kharagpur)
4. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5. https://unctad.org/system/files/official-document/ditcted10_en.pdf

SUBJECT CODE: 22UEC609N	Sensor Technology	Credits: 03
L:T:P - 3 : 0 : 0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
Sensor Fundamentals: Introduction, Definition, Types, and Sensor Characteristics **Principles of Sensing**: Capacitive, Magnetic, Inductive, Resistive, Piezoelectric, Piezoresistance, Pyroelectric, Hall effect. **Interfacing Electronic Circuits:** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, A to D Converters, Bridge Circuits, Data Transmitters, Batteries for low power sensors	
UNIT–II	**10 Hrs.**
Overview of Sensor Materials: Sensor materials and material properties, Surface Processing of materials for development of Sensors. **Sensor Technologies:** Micro technology**,** Micro-Electro-Mechanical Systems Technology, Nanotechnology **Sensor Applications:** Displacement Sensing, level & Velocity Sensors, Accelerometers, Tactile Sensors, Pressure Sensors, Temperature Sensors, Combdrive Sensors.	
UNIT–III	**10 Hrs.**
Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. **Strain gauge:** Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature. **Capacitive sensors:** Stretched diaphragm type: microphone, response characteristics. Piezoelectric element: piezoelectric effect **Case Study:** Piezoelectric and Capacitive Pressure Sensors, Cantilever based DNA Sensor, CNT based Pressure Sensor.	
UNIT–IV	**10 Hrs.**
Microfabrication/Micromachining of sensors: Overview of micro fabrication, silicon wafer extraction and cleaning, structural and sacrificial materials in microfabrication, lithography, deposition, doping, etching, Introduction to MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods.	

Reference Books *

1. Jacob Fraden, "Handbook of Modern Sensors: Physical Design & Applications", AIP Press, Springer.
2. D. Patranabis, "Sensors & Transducers", PHI Publication New Delhi.
3. Frank Vahid, Tony Givargis, "Embedded system Design",JohnWieley& Sons, Inc, 2002
4. H.K.P. Neubert, "Instrument transducers",Oxford University press.
5. E.A.Doebelin, "Measurement systems: application & design",Mc Graw Hill.
6. Tai, Ran Hsu,"MEMS and microsystems: design and manufacture", TMH, 2002.

Course Outcomes**

After completion of the course student will be able to

1. Use concepts for converting a physical parameter into an electrical quantity
2. Identify appropriate sensor materials and technology while designing sensors
3. Comprehend working principle of mechanical, strain gauge and capacitive sensors.

4. Comprehend the fabrication of various sensor.

* Books to be listed as per the format with decreasing level of coverage of syllabus
** Each CO to be written with proper action word and should be assessable and quantifiable

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1: Use concepts in common methods for converting a physical parameter into an electrical quantity	3	3	2			2		2				2	3	1	
CO2: Identify and use appropriate sensor materials and fabrication technology	3	1	2			3			2			3	3	2	
CO3: Comprehend working principle of mechanical, strain gauge and capacitive sensors.	3	3	3		2	2				1		2	3	2	
CO4: Comprehend the fabrication of various sensor.	3	3	1	2	3	3	3	3		1	2	3	3	3	