GOVERNMENT OF INDIA
MINISTRY OF
PARLIAMENTARY AFFAIRS

सत्यमेव जयते

आजादी का अमृत महोत्सव

my GOV मेरी सरकार

PREAMBLE TO THE CONSTITUTION

PREAMBLE

WE, THE PEOPLE OF INDIA.

having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC **REPUBLIC** and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship:

EQUALITY of status and of opportunity;

and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this 26th day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

I have read the Preamble

23-01-2026

Signature

SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

("Deemed to be University u/s 3 of the UGC Act, 1956")
Accredited 'A+' Grade by NAAC(2nd Cycle)
Agalakote, B.H.Road, Tumkur – 572 107.KARNATAKA, INDIA.

No. SSAHE/ACA-S&C/99/UG (BE)/2026 **Date: 23/09/2026**

NOTIFICATION

Sub:- Ordinance pertaining to Curriculum of Undergraduate Programme in Bachelor Engineering (3rd year Electronics and Communication Engineering)

Ref: Proceedings of the 32nd Academic Council meeting held on 28/07/2026 vide agenda no. SSAHE/AC/XXXII-52/2026 .

In exercise of the powers vested under section 6 of 6.05 of MoA / Rules of SSAHE, the Revised Ordinance pertaining to Curriculum of Undergraduate Programme in Bachelor of Engineering disciplines (3rd year Electronics and Communication Engineering) is notified herewith as per Annexure.

By Order,

REGISTRAR

REGISTRAR
Sri Siddhartha Academy of Higher Education
Agalakote, B.H. Road, Tumkur - 572 107.

To,

Dean / Principal, Sri Siddhartha Institute of Technology,

Copy to:

1) **Office of the Chancellor, SSAHE, for kind information,**
2) **PA to Vice-Chancellor / PA to Registrar / Controller of Examinations / Finance Officer, SSAHE**
3) **All Officers of the Academy Examination Branch / Academic Section / Guard File / Office copy.**

Syllabus for the Academic Year 2026-27

Vision

Mould quality technocrats in the field of Electronics and Communication with human values to cater the societal needs.

Mission

- To impart high-quality academic environment.
- To provide training in new tools and technologies.
- To facilitate continuous learning and research environment.
- To inculcate professionalism with ethical values, with little impact on environment.

Program Educational Objectives

PEO-1: Proficient to apply the knowledge gained in mathematics, science and engineering to the field of electronics and communication engineering for the synthesis and analysis of systems.
PEO-2: Competent to pursue higher studies and research, with effective communication.
PEO-3: Aware of new technologies in the domain field, apply the same for the societal requirement minimizing the impact on environment and ethical practices in their domain.

Knowledge and Attitude Profile (Washington Knowledge)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that

supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering insociety and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc., with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its

impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

PSO1: The ability to identify, analyse and design systems related to modern engineering hardware and software tools, in Electronics and Communication Engineering in the areas of electronics, communication, image processing, VLSI, signal processing and embedded systems for solving day to day problems.

PSO2: Impart the awareness about the impact of professional engineering solutions in societal and environmental context, professional ethics and be able to communicate effectively.

Syllabus for the Academic Year 2026-27

5th Semester B.E. — Academic year 2026-27

Sl. No.	Course Code		Course Title	Teaching Dept.	Teaching Hrs					Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs
					L	T	P	S	Total					
1	PC	22EC501	Embedded System Design	EC	42	-	-	48	90	3	50	50	100	3
2	PC	22EC502	Digital Signal Processing	EC	42	-	28	50	120	4	50	50	100	3
3	PC	22EC503	Principles of CMOS VLSI design	EC	42	-	28	50	120	4	50	50	100	3
4	PE	22EC5PE4x	Professional Elective-I	EC	42	-	-	48	90	3	50	50	100	3
5	OE	22EC5OE5x	Open Elective-I	EC	42	-	-	48	90	3	50	50	100	3
6	HS	22IE56X	Institutional Elective (561: Research Methodology, 562: Management and Entrepreneurship, 563: Project Management)	EC	28	-	-	32	60	2	50	50	100	3
7	PC	22EC507	Dept. Skill Lab – 3 (Embedded system design lab using ARM)	EC	14	-	28	18	60	2	50	50	100	3
8	HS	22SK508	Skill Development-II	T&P	-	-	28	2	30	1	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, S: Student academic activity, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	**252**	**0**	**112**	**296**	**660**	**22**	**400**	**350**	**750**	-

Professional Elective - I		Open Elective - I	
22EC5PE41	Digital Image Processing and Computer Vision	22EC5OE51	Sensors and Instrumentation
22EC5PE42	Robotics and Automation	22EC5OE52	Information Theory and Coding
22EC5PE43	Python Programming	22EC5OE53	Digital System Design using Verilog
22EC5PE44	Sensors and signal conditioning		

Syllabus for the Academic Year 2026-27

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Embedded System Design				
Subject Code:	**22EC501**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the fundamentals of embedded systems and their design constraints.
2	**Explore** different types of processor and memory technologies used in embedded systems.
3	**Study** the communication protocols and interfacing techniques for embedded applications
4	**Outline** the role of RTOS and software architectures in real-time embedded systems.

Module	**Description**	**Hrs**
I	**Introduction:** Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them, processor technology, design technology, IC technology. (Text 1: 1.1 to 1.5)	**8**
II	**General-purpose processors:** Basic architecture, operation, programmer's view, development environment, ASIPS. **Single-purpose processors:** Standard single-purpose peripherals, timers, counters, UART, PWM, LCD controllers, keypad controllers, stepper motor controller, ADC and DAC converters. (Text 1: 3.1 to 3.6, 4.1 to 4.8)	**9**
III	**Memory:** Introduction, common memory types, composing memory, memory hierarchy and cache, cache replacement policies. **Interfacing:** Serial Protocols: I2C, CAN, FireWire , USB. Parallel Protocols: PCI Bus, ARM Bus. Wireless protocols: IrDA, bluetooth, IEEE 802.11. (Text 1: 5.1 to 5.5, 6.9 to 6.11)	**9**
IV	**Interrupts:** Basics: Shared data problem, interrupt latency,	

	Survey of software architectures: Round robin, round robin with interrupts, function queues scheduling RTOS architecture. (Text 2: 4.1 to 4.4, 5.1 to 5.4)	**8**
V	**Introduction to RTOS:** Task- states, semaphores and shared data. more operating systems services - massage queues, mail boxes, pipes, timers, events, memory management. (Text 2: 6.1 to 6.3, 7.1 to 7.4)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Embedded System Design: A Unified Hardware/Software Introduction	Frank Vahid	Pearson Education, Second Edition, 2014 ISBN:9971- 51-405-2 2002
2	An Embedded software Primer	David E. Simon	CISCO Press, 2017. ISBN:81-7758-154-6 2006

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Embedded Systems: Architecture and Programming	Raj Kamal	TMH. 2008 Education Asia / PHI Indian Reprint 2002
2	Introduction to Embedded Systems	Shibu K.V	McGraw-Hill Education(INDIA) Private limited, 2012
3	Embedded Systems: A Contemporary Design Tool	James K	John Weily India Pvt. Ltd 2014

Course outcome	Descriptions
CO1	**Interpret** the design metrics, processor, and IC technologies used in embedded system design.
CO2	**Analyze** the Differences between general-purpose and single-purpose processors and their applications in embedded systems.
CO3	**Compare** the classification of different memory types and communication protocols used for interfacing in embedded systems.
CO4	**Illustrate** interrupt handling techniques and evaluate various embedded software architectures.
CO5	**Design** RTOS-based embedded solutions using semaphores, message queues, and events.

Course Outcomes:

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2	2	1											
CO3	2												
CO4		2											
CO5		1	2		2						2		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal	IA-1	90	50	20	16

	Assessment	IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination (SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Digital Signal Processing				
Subject Code:	**22EC502**	**L – T – P – S:**	**42-0-28-50 (In Hrs)**	
			Credits:	**4**

Sl. No.	**Course Objectives**
1	**Study** the basics of digital signal processing.
2	**Familiarize** the FFT algorithms for efficient DFT computation.
3	**Learn** the concepts of analog and digital filter design and its structures.
4	**Outline** the architecture and instruction set of TMS32067xx processor.

Module	**Description**	**Hrs**
I	**Frequency Domain Sampling:** Introduction, frequency domain sampling and reconstruction of discrete time signals, Discrete Fourier Transform (DFT): Discrete fourier transform, DFT as a linear transformation, relationship of DFT to other transforms, properties of DFT (without derivation). (Text 1: 7.1, 7.2)	9
II	**Linear Filtering:** Introduction, use of DFT in linear filtering, Filtering long data sequences: overlap-save, overlap-add method Fast Fourier Transform (FFT) algorithms: Direct computation of DFT, Radix-2 FFT algorithm: Decimation-in-time algorithm, decimation-in-frequency algorithm (without derivation). (Text 1: 7.3.1, 7.3.2, 8.1.1 to 8.1.3)	9
III	**FIR filters and its applications:** Introduction, design of FIR filters: Symmetric and antisymmetric FIR filters, design of linear phase FIR filters using windows and frequency sampling methods, FIR differentiators. **Structures for FIR systems:** Direct form structures, cascade form structures and linear phase structures. (Text 1:10.2.1, 10.2.2 to 10.2.3, 10.2.5,10.2.6, 9.2.1 and 9.2.2)	8
IV	**IIR filters:** Introduction, analog filter specifications, classification of analog filters: butterworth and chebyshev	8

	approximations, frequency transformations. Design of analog filters: Digital IIR filter design using impulse invariant technique, bilinear transformations. IIR filter structures: Direct form (I and II), cascade, parallel structures. (Text 1: 10.3.2, 10.3.3, 10.3.5, 9.3.1, 9.3.3, 9.3.4)	
V	**Architecture and instruction set of TMS320C67x processor**: Introduction, architecture, pipelining, linear and circular addressing modes, instruction sets, assembler directives, interrupts, memory considerations, fixed and floating-point formats, implementation of FIR and IIR filters. (Text 2: 3.1 to 3.9.3, 3.14, 3.18, 4.7, 5.4)	8

LAB CONTENT:

Sl. No.	Experiment Description
	Experiments using simulation tool
1	Compute N point DFT of a given sequence and to plot magnitude and phase spectrum and verification of its properties.
2	Compute the linear convolution and circular convolution of two sequences using DFT and IDFT and plot the graphs.
3	Compute autocorrelation and cross correlation of a given sequence and verification of its properties and plot the graphs.
4	For a given difference equation, determine i) Impulse response ii) Step response iii) Steady state response iv) Steady state response with initial conditions and plot the graphs.
5	Design of FIR filter for given specifications and plot the magnitude and phase response.
6	Design of IIR filter for given specifications and plot the magnitude and phase response.
7	Application of FIR filters: Design of differentiator.
	Experiments using DSP processor (C program)
8	Compute the linear convolution and circular convolution of two given sequences.
9	Computation of N- Point DFT of a given sequence.
10	Compute the Impulse response of first order and second order system.

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital Signal Processing: Principles, Algorithms and Applications	J. G. Proakis, D. G. Manolakis	Pearson Education Asia/Prentice Hall of India, 4th Edition,2014
2	Digital Signal Processing and Applications with TMS320C6713 and TMS320C6416 DSK	Rulph Chassaing, Donald Reay	Wiley India, 2nd Edition,2014

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital Signal Processing: A Computer based Approach	S. K. Mitra	McGraw Hill, 4th Edition,2013
2	Digital Signal Processors –Architectures, Implementations and Applications	Sen M. Kuok, Woon-Seng S. Gan	Pearson/ Prentice Hall,2005
3	Digital Signal Processing: A Practical Approach	Emmanuel Ifeachor, Barrie W. Jervis	2nd Edition, Pearson Education ,2002

Course Outcomes:

Course outcome	Descriptions
CO1	**Apply** and model linear filtering applications on digital signals using DFT.
CO2	**Interpret** and **realize** the computational complexity of DFT using FFT algorithms.
CO3	**Design** and **implement** FIR digital filters.
CO4	**Construct** and **illustrate** digital IIR filters.
CO5	**Describe** the architecture and instruction set of TMS32067xx

	processor.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				2								
CO2		1			2								
CO3		3	2		3						2		
CO4		3	2		3						2		
CO5	2												

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No	**Components**		**Duration(min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	15	12
		IA-2	90	50	15	
2	Periodic Lab Assessment		-	30	10	4
3	Lab CIE		-	20	5	2
4	One Open Ended Experiment/ Project		-	10	5	2
	Total CIE			**150**	**50**	**20**

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module
Rubrics for Periodic Lab Assessment: Attendance (5M), Lab record (10 M), Conduction of Experiments(10M) and Viva(5M)-**Total 30M**
Lab CIE: Write-up(5M), Conduction/Execution/Demonstration(10M) and Viva(5M)-**Total 20M**
One Open Ended Experiment/ Project: Experimental / project Design (4 marks), Execution/demonstration (3 marks) and Analysis/Viva (3 marks)- **Total 10M**

Semester End Examination(SEE) : **Max 100 Marks,** Duration: 3 Hrs
The question paper shall contain 10 full questions (20 marks each), with 2 questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.
Minimum passing Marks : 40% of Max Marks

Department: Electronics and Communication Engineering			Semester:	5
Subject: Principles of CMOS VLSI Design				
Subject Code:	22EC503	L – T – P – S:	42-0-28-50 (In Hrs)	
			Credits:	4

Sl. No.	Course Objectives
1	**Understand** the VLSI design flow, MOSFET switching behavior, CMOS logic gates, and circuit representation using stick diagrams and transmission gates.
2	**Learn** the MOS transistor characteristics, CMOS inverter behavior, and **explain** fabrication concepts with lambda-based design rules in layout design.
3	**Study** circuit parameters including resistance, capacitance, delay, and switching characteristics in CMOS circuits.
4	**Explore** CMOS subsystems, memory elements, and the impact of scaling models on device performance.

Module	Description	Hrs
I	**Overview of VLSI:** Introduction, VLSI design flow, ideal switches and boolean operations, MOSFET as switches, FET threshold voltage concepts, pass transistors and characteristics, CMOS logic - basic gates and compound gates, mos layers, layout and stick diagrams of simple logic gates, transmission gate circuits. (Text 1: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5. Text Book 2: 3.1,3.2,3.7)	**10**
II	**MOS Transistor theory:** Introduction, I-V Characteristics, DC analysis of CMOS inverter. **Fabrication:** nMOS fabrication, CMOS fabrication, lambda-based design rules. (Text 1: 7.1, Text Book 2: 1.7, 1.8, 2.1.1,2.1.2, 3.3.1)	**8**
III	**Basic Circuit Concepts:** Sheet resistance, area capacitances, capacitance calculations. delay unit, inverter delays, switching characteristics, rise time and fall time calculations, propagation	**8**

	delay. (Text 2: 4.1,4.3,4.4,4.5,4.6, Text 1: 7.2.1,7.2.2, 7.2.3)	
IV	**CMOS subsystem design and process:** Architectural issues, switch logic, gate logic-NMOS and BiCMOS of inverter, NAND and NOR, ALU subsystem design-datapath of a processor, standard adder element design, implementation of 4-bit adder and ALU. (Text 2: 6.1, 6.2, 6.3.1,6.3.2,6.3.3, 8.2, 8.3)	**8**
V	**Memory elements**: Static RAM-general SRAM cell, 6T and 4T SRAM models, multiport SRAM, SRAM arrays, DRAM- 1T DRAM cell, write and read operations. **Scaling of MOS circuits:** Constant voltage, constant field, combined voltage and dimension scaling models, scaling factors for device parameters. (Text 1: 13.1,13.2,13.3, Text 2: 5.1, 5.2)	**8**

LAB CONTENT:

Sl. No.	Experiment Description
1.	Realization of given Boolean function using pass transistors.
2.	Transient analysis of CMOS logic for given Boolean function.
3.	Transient analysis of transmission gate.
4.	Transient analysis of 2:1 MUX using transmission gate.
5.	Realization of NMOS inverter.
6.	Realization of pseudo-NMOS inverter.
7.	Transient analysis of CMOS inverter, layout design and post simulation.
8.	Transient analysis of NAND2, layout design and post simulation.
9.	Transient analysis of NOR2, layout design and post simulation.
10.	Parametric analysis of CMOS inverter and realization of symmetrical inverter.
Note: The experiments are conducted using Cadence.	

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Introduction to VLSI circuits and systems	John P Uyemura	John Wiley & sons, 4th Edition, 2006
2	Basic VLSI Design	Douglas A. Pucknell & Kamran Eshraghian	PHI,3rd Edition,2005

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	CMOS VLSI Design: A Systems Perspective	Neil H. E. Weste, David Harris and Ayan Banerjee	Pearson Education Pvt. Ltd.,3rd Edition,2006
2	Fundamentals of Semiconductor Devices	M. K. Achuthan and K.N. Bhat	Tata McGraw-Hill, 2nd Edition,2006
3	CMOS Digital Integrated Circuits: Analysis and Design	Sung-Mo Kang & Yusuf Leblebici	Tata McGraw-Hill 3rd Edition,2003
4	Modern VLSI Design- IP Based Design	Wayne Wolf	PHI Publishers, 4th Edition,2009

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the VLSI design flow, MOSFET switching behavior, threshold voltage concepts, and CMOS logic gates; interpretation of simple circuit layouts using stick diagrams, MOS layers, and transmission gate circuits.
CO2	**Interpret** the I-V characteristics and DC behavior of CMOS inverters, and **apply** MOS fabrication concepts and lambda-based design rules in the design of CMOS circuits.

CO3	**Compute** circuit parameters, evaluation of inverter delays, switching characteristics, and timing parameters in CMOS circuits.
CO4	**Design** CMOS subsystems, and implementation of standard adder elements and 4-bit ALU datapaths.
CO5	**Construct** SRAM and DRAM memory cells, and **examine** the impact of device scaling models and parameters on VLSI performance.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				2								
CO2	3	2			2								
CO3	3	3	2		3								
CO4	3	2	3		3						2		
CO5	3	2	2								2		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No	**Components**		**Duration(min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	15	12
		IA-2	90	50	15	
2	Periodic Lab Assessment		-	30	10	4
3	Lab CIE		-	20	5	2
4	One Open Ended Experiment/ Project		-	10	5	2
	Total CIE			**150**	**50**	**20**
IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module **Rubrics for Periodic Lab Assessment:** Attendance (5M), Lab record (10 M),						

Conduction of Experiments(10M) and Viva(5M)-**Total 30M** **Lab CIE:** Write-up(5M), Conduction/Execution/Demonstration(10M) and Viva(5M)-**Total 20M** **One Open Ended Experiment/ Project:** Experimental / project Design (4 marks), Execution/demonstration (3 marks) and Analysis/Viva (3 marks)- **Total 10M**
Semester End Examination(SEE) : **Max 100 Marks,** Duration: 3 Hrs The question paper shall contain 10 full questions (20 marks each)**,** with 2 questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice**.** Each question may have a maximum of 4 sub-divisions**.** **Minimum passing Marks : 40% of Max Marks**

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Digital Image Processing and Computer Vision				
Subject Code:	**22EC5PE41**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Introduce** the concepts of image processing and basic analytical methods in image processing.
2	**Explore** image enhancement techniques in spatial and frequency domains.
3	**Understand** image transformation techniques for the image analysis.
4	**Learn** the feature extraction techniques for object detection applications.

Module	**Description**	**Hrs**
I	**Digital image fundamentals:** Introduction, digital image processing definition, fundamental steps in digital image processing, classification of digital images, image file formats, applications of digital image processing. **Convolution and correlation:** 2D convolution through graphical method, convolution through Z transform, circular convolution, correlation through matrix analysis. (Text 1: 1.1 to 1.4, Text2: 1.9 to 1.10, 3.1 to 3.7)	**9**
II	**Elements of visual perception:** Introduction, structure of human eye, image formation in an eye, brightness adaptation and discrimination, light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, some basic relationship between pixels: neighbors of a pixel, adjacency, connectivity, regions, and boundaries, distance measures. (Text 1: 2.1 to 2.5)	**8**
III	**Image transforms:** Introduction, two dimensional orthogonal and unitary transforms, properties of unitary transforms, two-dimensional discrete fourier transform, discrete cosine transforms, sine transforms, Hadamard transform, Haar	**8**

	transform. (Text 2: 4.1 to 4.12)	
IV	**Intensity transformations and spatial filtering:** Introduction, image negative, log transformation, power law(gamma transformation), piecewise-linear transformation functions. **Histogram processing:** Histogram equalization, histogram matching, linear gray level transformation, local or neighborhood operation, median filter, spatial domain high pass filtering or image sharpening, bit plane slicing, image enhancement in the frequency domain, homomorphic filter, zooming operation, image arithmetic. (Text 1:3.1 to 3.4, Text2: 5.1 to 5.15)	**9**
V	**Image segmentation and feature extraction:** Introduction, point, line, and edge detection, thresholding, segmentation by region growing and by region splitting and merging, boundary preprocessing, boundary feature descriptors, region feature descriptors, principal components as feature descriptors. (Text 1: 10.1 to 10.4, 11.1 to 11.5)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital Image Processing	Rafael C. Gonzalez, Richard E. Woods	Pearson Education Pvt. Ltd, 4th edition 2018.
2	Digital Image Processing	Jayaraman	Tata McGraw-Hill Education, 3rd Edition 2012.

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Fundamentals of Digital Image Processing	Anil Jain K	PHI Learning Pvt. Ltd., 2011
2	Digital Image Processing	William K. Pratt	John Wiley, 4th Edition, 2007

Course Outcomes:

Course outcome	Descriptions
CO1	**Derive** mathematical representation of various types of images and image processing systems.
CO2	**Describe** various image enhancement techniques in spatial domain and frequency domain.
CO3	**Analyze** digital images using suitable image transformation techniques.
CO4	**Apply** segmentation and feature extraction techniques on images to extract the region of interest.
CO5	**Interpret** computer vision algorithms for feature extraction, image segmentation, and object recognition.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1										
CO2	1		3		2								
CO3		3											
CO4		1		2									
CO5		2	2										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal	IA-1	90	50	20	16

	Assessment	IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each)**,** with **2** questions from each of the 5 Modules**,** ensuring 100% syllabus coverage**.** Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Robotics and Automation				
Subject Code:	**22EC5PE42**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Introduce** the fundamental concepts in robotics.
2	**Learn** the concepts of kinematics.
3	**Understand** the coordinate transformation, trajectory planning and control techniques.
4	**Study** the sensors and devices in robot applications and vision analysis.

Module	**Description**	**Hrs**
I	**Basic concepts of robotics:** Introduction, evolution of robots and robotics, laws of robot, robot definition, generations of robots, robot anatomy, coordinate frames, mapping and transforms. (Text 1: 1.1 to 1.6, 2.1to 2.5)	8
II	**End effectors:** Introduction, grippers – mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers; two fingered and three fingered grippers; internal grippers and external grippers; selection and design consideration. (Text 2: 5.1 to 5.4)	9
III	**Kinematics:** Introduction, direct kinematic model: mechanical structure and notations, description of joints and links. kinematic modeling of the manipulator. Denavit –Hartenberg notation. ROBO software implementation of kinematic models. (Text1: 3.1 to 3.4)	9
IV	**Path planning:** Introduction, trajectory planning, trajectory planning problem, terminology, steps in trajectory planning, classification of trajectory planning, types of trajectory function tasks, joint space techniques, cartesian space technique. (Text 1: 7.1 to 7.8)	8

V	**Robotic sensors and vision:** Introduction, sensors and robotics, kinds of sensors used in robotics. robotic vision, industrial applications of vision –controlled robotic vision systems. (Text 1: 9.1 to 9.5)	8

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Robotics And Control	R K Mittal And I J Nagarth	Mc Graw – Hill, 2003
2	Industrial Robotics – Technology, Programming and Applications	M.P.Groover	McGraw-Hill, 2001

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Robotics Control, Sensing, Vision and Intelligence	Fu.K.S. Gonzalz.R.C., andLee C.S.G.	Mc Graw – Hill, 1987
2	Robotic engineering- AnIntegrated Approach	Richard D. Klafter, Thomas A. Chmielewski and Michael Negin,	Prentice Hall Inc, 1989

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the basics and the classifications of robotic systems.
CO2	**Analyze** the end effectors of robotics.
CO3	**Apply** kinematic models using Denavit–Hartenberg notation and implement them using simulation software.
CO4	**Interpret** the kinematics and path planning for robotic systems.
CO5	**Design** sensors and robotics for industrial applications.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1											
CO2		2			2								
CO3			3	2	2								
CO4		2	2								2		
CO5		2		2	3						2		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks : 40% of Max Marks.**

Syllabus for the Academic Year 2026-27

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Python Programming and Applications				
Subject Code:	**22EC5PE43**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the fundamentals of Python scripts.
2	**Learn** core Python scripting elements such as variables and flow control structures.
3	**Study** Python functions to facilitate code reuse.
4	**Acquire** the knowledge of numpy package and machine learning application of Python.

Module	**Description**	**Hrs**
I	**Parts of python programming language:** Data types, indentation, comments, reading input, print output, type conversions, the type() function and is operator, dynamic and strongly typed language. **Control Flow Statements:** The if decision control flow statement, the if…else decision control flow statement, the if…elif…else decision control statement, nested if statement, the while loop, the for loop, the continue and break statements. **Functions:** Built-in functions, commonly used modules, function definition and calling the function, the return statement and void function, scope and lifetime of variables. (Text 1: 2.7- 4.8)	**9**
II	**Strings:** Creating and storing strings, basic string operations, accessing characters in string by index number, string slicing and joining, string methods, formatting strings. **Lists:** Creating Lists, basic list operations, indexing and slicing in lists, built-in functions used on lists, list methods, the del statement. (Text 1: Chapter 5 and 6)	**9**

III	**Dictionaries:** Creating dictionary, accessing and modifying key: value pairs in dictionaries, built-in functions used on dictionaries, dictionary methods, the del statement. **Tuples and sets:** Creating tuples, basic tuple operations, indexing and slicing in tuples, built-in functions used on tuples, relation between tuples and lists, relation between tuples and dictionaries, tuple methods, using zip() function, sets, set methods, traversing of sets. (Text 1: Chapter 7 and 8)	**8**
IV	**NumPy basics**: Arrays and vectorized computation: The numpy ndarray: A multidimensional array object: Creating ndarrays, Data types for ndarrays, arithmetic with numpy arrays, basic indexing and slicing, boolean indexing, fancy indexing, transposing arrays and swapping axes, universal functions: fast element-wise array functions, array-oriented programming with arrays: expressing conditional logic as array operations, mathematical and statistical methods, methods for boolean arrays, pseudorandom number generation. (Text 2: 4.1 – 4.6)	**8**
V	**Applications of python in machine learning**: Basics of machine learning, problems that machine learning can solve, task and data, essential libraries and tools- jupyter notebook, numpy, scipy, matplotlib, pandas. (Text 3: 1.1 -1.5)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Introduction to Python Programming	Gowri shankar S, Veena A	1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
2	Python for Data Analysis	Wes McKinney	2nd Edition, O'Reilly Media, ISBN: 978-1-491-95766-0, 2018
3	Introduction to machine learning with python	Andreas C. Müller and Sarah Guido	1st edition, O'Reilly Media, Inc, 2016, 978-1-449-36941-5

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Data Analytics using Python	Bharti Motwani	2nd edition, Wiley Publications, June 2020, ISBN-13: 978-8126502950,
2	Python Programming	John M Zelle	Ingram short title , 3rd edition, 2018, ISBN No.: 1590282752
3	Python Crash Course	Eric Matthes	Python Crash Group, 2020, 2nd Edition, ISBN No. : 1593279280
4	Python For Beginners: The Easiest and Quickest Way to Learn Python Coding	Ike Beck	Siemen Mayer, Edition 2022, ISBN No.: 9783986532222

Course Outcomes:

Course outcome	Descriptions
CO1	**Interpret** the core principles of Python, such as its object-oriented nature and dynamic typing, by explaining how they contribute to the language's readability and flexibility.
CO2	**Demonstrate** the creation of lists, tuples, and dictionaries, and illustrate various methods for adding, removing, and modifying elements within each data structure.
CO3	**Implement** Python programs to solve practical problems, such as sorting a list of numbers or counting word frequencies in a given text file.
CO4	**Analyze** the utility of numpy python package and its features.
CO5	**Describe** the machine learning applications using python.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1		2								
CO2	2	1			2								
CO3		2	2		2								
CO4		2	1		1								
CO5	1												

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE): Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks: 40% of Max Marks.**

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Sensors and Signal Conditioning				
Subject Code:	**22EC5PE44**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** various technologies associated in manufacturing of sensors.
2	**Acquire** knowledge about types of sensors used in modern digital systems.
3	**Learn** about material properties required to make sensors.
4	**Study** intelligent sensors used in signal processing.

Module	**Description**	**Hrs**
I	**Introduction to sensor bases measurement systems**: Introduction, general concepts and terminology, sensor classification, primary sensors, material for sensors, micro sensor technology, magneto resistors, light dependent resistors, resistive hygrometers, resistive gas sensors, liquid conductivity sensors (Text1: 1.2 to 1.8)	9
II	**Reactance variation and electromagnetic sensors:** Introduction, capacitive sensors, inductive sensors, electromagnetic sensors. signal conditioning for reactance variation sensors-problems and alternatives, ac bridges carrier amplifiers, coherent detection, specific signal conditioners for capacitive sensors, resolver-to-digital and digital-to-resolver converters. (Text1: 2.4 to2.10)	9
III	**Self-generating sensors**: Introduction, Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors. (Text1: 3.6 to 3.12)	8
IV	**Digital and intelligent sensors**: Introduction, position encoders, resonant sensors, sensors based on quartz	

	resonators, SAW sensors, vibrating wire strain gages, vibrating cylinder sensors, digital flow meters. (Text 1: 4.1 to 4.12)	8
V	**Sensors based on semiconductor junctions:** Introduction, Thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge coupled sensors – types of CCD imaging sensors, ultrasonic-based sensors. (Text 1: 6.2 to 6.13)	8

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Ramon PallásAreny, John G. Webster	"Sensors and Signal conditioning",	John Wiley and Sons , 2nd Edition, 2000

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Wai Lok, Bin Gai	Sensor Signal and Information Processing	John Willey , 2nd Edition, Feb 2020
2	Curtis D Johnson,	Process Control Instrumentation Technology	Pearson New International Technology , 4th Edition, June 2020

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** various types of sensors and their construction.
CO2	**Identify** the sensors for specific end user application.
CO3	**Apply** the knowledge of sensors for developing prototype models.
CO4	**Analyze** the sensors performance in integrated system design.
CO5	**Select** appropriate sensors for signal conditioning.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1											
CO2	2		2		3								
CO3	2												
CO4	2			3							3		
CO5		1	1										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks : 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	5
Subject: Sensors and Instrumentation				
Subject Code:	22EC5OE51	L – T – P – S:	42-0-0-48	(In Hrs)
			Credits:	3

Sl. No.	Course Objectives
1	**Study** the commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
2	**Learn** the use of sensors for measurement of displacement, force and pressure.
3	**Understand** the fundamentals of intelligent sensors.
4	**Acquire** the knowledge about the data acquisition system using ADC.

Module	Description	Hrs
I	**Sensors & transducer:** Introduction to sensors/transducers, principles, classification, parameter, environmental parameters, characterization. (Text 1: 1.1 to 1.6)	8
II	**Mechanical and electromechanical sensors:** Introduction, resistive potentiometer, strain gauge, inductive sensors, capacitive sensors, force sensors, ultrasonic sensors. (Text 1: 2.1 to 2.7)	8
III	**Thermal, magnetic and radiation sensors:** Introduction, gas thermometric sensors, thermal expansion type thermometric sensors, acoustic temperature sensors, magneto resistive sensors, hall effect sensors, inductive and eddy current sensors, basic characteristics of radiation sensors, types of photo detectors. (Text 1: 3.1 to 3.4, 4.1 to 4.5, 5.1,5.2 and 5.3)	8
IV	**Data acquisition and conversion:** Introduction, objectives of data acquisition system, signal conditioning of inputs, single channel DAS, multichannel DAS, computer based das, digital to analog converters and analog to digital converters. (Text 2: 6.1 to 6.7)	9

V	**Smart sensors:** Introduction, primary sensors, excitation, amplification, filters, converters, compensation, information or processing, data communication, the automation. (Text 2: 7.1 to 7.10)	9

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Sensors and Transducers	D Patranabis	PHI , 2nd edition, 2013
2	Electronic Instrumentation	H.S.Kalsi	TMH , 2nd edition, 2008

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	PC interfacing for Data Acquisition & Process Control	S. Gupta, J.P. Gupta	Instrument Society of America, 2nd edition, 1994
2	Lab VIEW Graphical Programing II	Gary Johnson	McGraw Hill , 2nd edition, 1997

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the theory and working of sensors and instrumentation systems.
CO2	**Illustrate** the use of mechanical, thermal, magnetic and radiation sensors.
CO3	**Identify** and use of different data acquisition systems.
CO4	**Apply** intelligent instrumentation in industrial automation.
CO5	**Evaluate** the sensors and smart sensors.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1											
CO2		2	1										
CO3	2		2										
CO4		2	1	2									
CO5	1	2		1									

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks : 40% of Max Marks.**

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Information Theory and Coding				
Subject Code:	**22EC5OE52**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the concept of source entropy and information rate with reference to dependent and independent sources.
2	**Study** various source encoding algorithms.
3	**Outline** the basics of discrete communication channels to compute channel capacity.
4	**Explore** various error control coding algorithms for reliable data transmission.

Module	**Description**	**Hrs**
I	**Information theory:** Introduction, measure of information, average information content of symbols in long independent sequences, average information content of symbols in long dependent sequences, some properties of entropy, extension of a dms, markoff statistical model for information sources, entropy and information rate of markoff sources. (Text 1: 4.1, 4.2, 4.3, 4.3.1) (Text 2: 2.1)	9
II	**Source coding:** Introduction, properties of codes, prefix codes, kraft mcmillan inequality property, code efficiency and redundancy, source coding theorem, huffman codes. (Text 2: 2.2, 2.3)	8
III	**Communication channels:** Introduction, discrete communication channels, channel models, channel matrix, joint probability matrix, system entropies, mutual information and properties of mutual information, rate of information transmission over discrete channel, channel capacity. (Text 2: 2.4 to 2.9) (Text 1: 4.5, 4.6)	8
IV	**Error control coding**: Introduction, methods of controlling errors, types of errors, types of codes, linear block codes: matrix description of linear block codes, error detection and error correction capabilities of linear block codes. (Text 1: 9.1,	8

	9.2)	
V	**Binary cyclic codes:** Introduction, algebraic structure of cyclic codes, encoding using an (n-k) bit shift register, syndrome calculation, error detection and correction. convolution codes: convolution encoder, time domain approach, transform domain approach. (Text 1: 9.3, 9.3.1, 9.3.2, 9.3.3) (Text 2: 8.6)	9

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital and Analog communication systems.	K. Sam Shanmugam	John Wiley India Pvt. Ltd, 2012
2	Digital communication.	Simon Haykin	John Wiley India Pvt. Ltd, 2013

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Error Control Coding.	Shu Lin and Daniel J Costello	Pearson Education Limited, 2nd Edition, 2011
2	ITC and Cryptography.	Ranjan Bose	TMH, 2nd Edition, 2007
3	Elements of Information Theory.	Thomas Cover, Joy Thomas	John Wiley, 1991

Course Outcomes:

Course outcome	Descriptions
CO1	**Identify** the basic knowledge for measuring information and entropy of independent & dependent sources.
CO2	**Analyze** source encoding algorithms to compress data effectively.
CO3	**Apply** the concepts of discrete communication channels to compute channel capacity for discrete communication channels.
CO4	**Construct** linear block codes for error detection and correction.

CO5	**Develop** binary cyclic and convolutional codes and apply them for error detection and correction.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2											
CO2	2		2										
CO3	3	2	1										
CO4	3	2	3										
CO5	2	2	3	1							1		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks: 40% of Max Marks.**

Department: Electronics and Communication Engineering			Semester:	5
Subject: Digital System Design Using Verilog				
Subject Code:	**22EC5OE53**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	Course Objectives
1	**Learn** the notions of digital system design using an integrated development environment for design entry through Verilog.
2	**Understand** the difference between concurrent and sequential programming.
3	**Study** verilog modelling styles for digital circuits.
4	**Acquire** knowledge of binary arithmetic circuits.

Module	Description	Hrs
I	**Introduction to verilog:** Introduction to HDL, history of HDLs, capabilities. Modules and ports, Expressions. Basic concepts: Lexical conventions, data types, system tasks and compiler directives. (Reference Text 2: 1.1 to 1.3, 2.1,4.1 to 4.2) (Text1:3.1 to 3.4,)	9
II	**Gate level modeling:** Gate types, gate delays, examples. Timing and delays: Types of delay models, path delay models. (Text1: 5.1 to 5.3,10.1 to 10.2)	8
III	**Behavioral modeling:** Structured procedures, procedural assignments, timing controls, conditional statements, multiway branching, generate blocks, examples. (Text1: 7.1 to 7.6, 7.8 to 7.10)	8
IV	**Data flow modeling:** Continuous assignments, delays, expression, operators and operands, operator types, examples. **Tasks and functions:** Difference between tasks and functions, tasks, functions. (Text1: 6.1- 6.6, 8.1 to 8.4)	8
V	**Design of networks for arithmetic operations:** Design of a serial adder with accumulator, state graphs for control networks, design of a binary multiplier, multiplication of signed binary numbers, design of a binary divider (Text2: 4.1 to 4.5)	9

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Verilog HDL A Guide to Digital Design and Synthesis	Samir Palnitkar	Pearson Education, Second edition, ISBN 81-7758-918-0 2008
2	Digital Systems Design using VHDL	Charles H. Roth. Jr	Thomson Learning ISBN 981-240-052-4, 2006

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	HDL programming (VHDL and Verilog)	Nazein M. Botros	Dreamtech press, 2009 ISBN-10: 8177226975,
2	A Verilog HDL Primer	J Bhasker	BS publications, Second edition, 2007 ISBN 81-7800-012-1
3	Verilog HDL	Joseph Cavanagh	CRC Press ,2007

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the constructs and conventions of the Verilog programming.
CO2	**Analyze** control networks for arithmetic operations.
CO3	**Design** combinational and sequential digital circuits.
CO4	**Develop** Verilog code for digital circuits using different modelling styles.
CO5	**Select** suitable abstraction level for a particular digital design

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2		2	1										
CO3			2		1								
CO4			2		2								
CO5		2	2										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks

Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks : 40% of Max Marks.**

Department: Electronics and Communication Engineering			**Semester:**	**5**
Subject: Research Methodology (Choice based)				
Subject Code:	**22IE561**	**L – T – P – S:**	**28-0-0-32 (In Hrs)**	
			Credits:	**2**

Sl. No.	**Course Objectives**
1	**Study** the research methodology and **explain** the technique of defining a research problem.
2	**Understand** literature review and various research designs and their characteristics.
3	**Explore** the details of sampling designs, and also different methods of data collections.
4	**Learn** the theoretical, conceptual frameworks, writing a review, the art of interpretation and the art of writing research reports.

Module	**Description**	**Hrs**
I	**Research methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process, criteria of good research, and problems encountered by researchers in India. **Defining the research problem:** Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. (Text 1: 1, 2)	6
II	**Reviewing the literature:** Place of the literature review in research, bringing clarity and focus to your research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, how to review the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. (Text 2: 3)	5

III	**Research design:** Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental designs. design of sample surveys: introduction, sample design, sampling and non-sampling errors, sample survey versus census survey, types of sampling designs. (Text 1: 3, 4.1 to 4.6)	7
IV	**Data collection:** Experimental and surveys, collection of primary and secondary data, selection of appropriate method for data collection, case study method. **Hypothesis-** Basic concepts, types of hypothesis, formulation of hypothesis, testing of hypothesis, analysis of data, interpretation of data- meaning of interpretation, technique of interpretation, precaution in interpretation, editing, classification and tabulation. (Text 1: 6, 9.1-9.4, 14.1 to 14.4)	6
V	**Report writing:** Significance of report writing, different steps in writing report, layout. types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports. research ethics, citations, similarity check. (Text 1: 14.5 to 14.20, Text 2: 6)	4

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Research Methodology: Methods and Techniques	C.R. Kothari, Gaurav Garg	New Age International 4th Edition, 2018
2	Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2)	Ranjit Kumar	SAGE Publications Ltd. 3rd Edition, 2011

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Research Methods: the concise knowledge base	Trochim	Atomic Dog Publishing2005
2	Conducting Research Literature Reviews: From the Internet to Paper	Fink A	Sage Publications 2009

Course Outcomes:

Course outcome	Descriptions
CO1	**Discuss** research methodology and the technique of defining a research problem.
CO2	**Explain** the functions of the literature review in research, carrying out a literature search.
CO3	**Develop** theoretical and conceptual frameworks and writing a review.
CO4	**Interpret** various research designs, their characteristics, the art of interpretation and the art of writing research reports.
CO5	**Compose** a comprehensive technical report by systematically executing the steps of data gathering, drafting, and applying a structured layout.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3		2					1	2			
CO2	2	2		1					2	2			
CO3	1	2	2	2					2	3	2		
CO4	2	2	1	3					3	3	2	2	
CO5	2	2	2						3				

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	5
Subject: Management and Entrepreneurship (Choice based)				
Subject Code:	22IE562	L – T – P – S:	28-0-0-32 (In Hrs)	
			Credits:	2

Sl. No.	Course Objectives
1	**Explain** fundamentals of management, functions of a manager, planning, organizing, and staffing, decision making processes and organizational structure.
2	**Describe** the understanding of motivation and different control systems in management, leadership process, Entrepreneurship and its development process.
3	**Know** about Small Scale Industries, industrial ownership, various types of supporting agencies and financing available for an entrepreneur and **summarize** the preparation of project report, need and significance of report writing.
4	**Define** various forms of the intellectual property, its relevance and business impact in the changing global business environment and **discuss** leading International Instruments concerning Intellectual Property Rights.

Module	Description	Hrs
I	**Introduction** - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, **Planning-** Nature, importance, types of plans, steps in planning, **Organizing-** nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection. **Directing and controlling-** meaning and nature of directing, leadership styles, motivation Theories, Communication- Meaning and importance, Coordination meaning and importance, Controlling- meaning, steps in controlling, methods of establishing control.	**6**

II	**Entrepreneur –** meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study.	**5**
III	**Preparation of project and ERP (Enterprise resource planning)** - meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, Enterprise Resource Planning: Meaning and Importance- ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation.	**5**
IV	**Micro and Small Enterprises**: Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises, case studies in respective domains. Institutional support: MSME-DI, NSIC, SIDBI, KIADB, KSSIDC, TECSOK, KSFC, DIC and District level single window agency.	**6**
V	**Intellectual Property:** Introduction to IP**:** Importance of IPR, International conventions / agreements / treaties, origin of IP law and history, laws related to IP in India: Indian patent act 1970, WIPO. **Patents:** Criteria for patentability, patentable and non-patentable matters, introduction to prior art search, types of patent application: ordinary, convention, PCT, divisional and patent of addition, filing procedure, drafting complete specification and claims. **Copyright:** Criteria, filing procedure, copyright infringement, rights of authorship and ownership, fair use, first sale doctrine, moral rights and economic rights. **Trademarks:** Definition, eligibility criteria, types of patents,	**6**

	filing procedure, classification of trademarks and well-known mark **Geographical Indications:** Definitions, importance, filing procedure, GI ecosystem in India and case laws. **Industrial design:** Eligibility criteria, non-protectable industrial designs india, procedure for registration, importance of design registration.	

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Principles of Management	P. C. Tripathi, P. N. Reddy	Tata McGraw Hill, 4th / 6th Edition, 2010.
2	Intellectual property rights - Unleashing the knowledge economy	Pmbuddha Ganguli	Tata McGraw Hill Publishing Company Ltd

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Management and Entrepreneurship	Kanishka Bedi	Oxford University Press-2017
2	Entrepreneurship Development	S S Khanka	S Chand & Co.
3	Dynamics of Entrepreneurial Development & Management -	Vasant Desai	Himalaya Publishing House

Course Outcomes:

Course outcome	Descriptions
CO1	**Explain** functions of a manager, planning and decision making processes, Organizational structure, staffing and leadership processes.

CO2	**Describe** the understanding of motivation and different control systems in management, understanding of Entrepreneurships and its development process.
CO3	**Outline** Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur. Summarize the preparation of project report, need and significance of report.
CO4	**Apply** the knowledge of patent and copyright for the innovative research works and provide the way for developing ones idea for innovations.
CO5	**Paraphrase** Intellectual Property and its types, Geographical Indications.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1							2	3	1	2			
CO2							3	3	2				
CO3									2	1			
CO4		1	1	1					2				
CO5										2			

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	

Total CIE	150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	5
Subject: Project Management (Choice based)				
Subject Code:	22IE563	L – T – P – S:	28-0-0-32 (In Hrs)	
			Credits:	2

Sl. No.	Course Objectives
1	**Understand** the scope, timing and quality of the project, and to analyze the project goals, constraints, deliverables, performance criteria, control needs and resource requirement in consultation with stake holders.
2	**Implement** the process of project management, life cycle and the embodied concepts, tools and techniques in order to achieve project success.
3	**Understand** the team efforts and stakeholders in professional manner, respecting differences, to ensure a collaborative project
4	**Apply** project management practices to new programs, initiatives, products, services and events relative to the needs of stakeholders.

Module	Description	Hrs
I	**Introduction:** Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Role of project manager and office, Ten Project Knowledge areas with their associated processes **Project integration management**: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase.	**6**
II	**Project scope management:** Plan scope management, collect requirements, define scope, create wbs (work breakdown structure), validate scope, control scope. **Project schedule management**: **Plan schedule management:** Define activities, sequence activities, estimate activity durations, develop schedule, and control	**5**

	schedule.	
III	**Project cost management:** Plan cost management, estimate cost, determine budget, and control costs. Project quality management: Plan quality management, manage quality and control quality. **Project resource management:** Plan resource management, estimate activity resources, acquire resources, develop team, manage team and control resources.	**6**
IV	**Project communication management:** Plan communication management , manage communications and monitor communications **Project risk management:** Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk responses, implement risk responses and monitor risks. **Project procurement management:** Plan procurement management, conduct procurement, control procurements.	**6**
V	**Project stake holder management:** Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement. A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above.	**5**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Project Management Book of Knowledge	Book of Knowledge	6th Edition, PMI, USA
2	Project Management	Dennis Lock	Taylor & Francis 10th Edition-2013

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Project Planning: Analysis, Selection, Implementation and Review,	Prasanna Chandra	MC- Graw Hill Education, 8th Edition, 2017.

2	Project Management-a system approach to planning, scheduling & controlling	Harold Kerzner	CBS publications and Distributions,2002

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the procedure for analyzing a project and define the rational of work break structure.
CO2	**Illustrate** the use of network techniques for successful project implementation.
CO3	**Design** the procedure for overall financial analysis of the project alongside the resources requirement and ideal quality.
CO4	**Identify** the sources and process for communication, risk management and procurement and **build** a comprehensive plan for the stakeholder management.
CO5	**Identify** stake holders, plan, management, engagement, and monitor.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		2	1		2		2	2	3	3			
CO2		2	2		1		2	3	3	3	2		
CO3		3	2		1		1	3	3	3	2		
CO4		1	2		1		2	3	3	3	2		
CO5		3	2				1	3		3			

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering	Semester:	5

Subject: Dept. Skill Lab-3 (Embedded system design lab using ARM)			
Subject Code:	22EC507	L – T – P - S:	14-0-28-18
		Credit	2

Sl. No.	Course Objectives
1	**Study** the architecture and programming of embedded controllers and peripherals.
2	**Understand** programs to interface peripheral devices using embedded C.
3	**Explore** real-time embedded applications involving timers, interrupts, and serial communication.
4	**Design** embedded systems using RTC, PLL, and watchdog timer concepts.

LAB CONTENT:

Sl. No	Experiment Description
1	Interface a 4x4 matrix keypad with the LPC2128 microcontroller and display the pressed key on the LCD.
2	Convert analog signals from a potentiometer to digital using the Analog-to-Digital Converter (ADC) of the LPC2128 microcontroller.
3	Generate PWM signals using the PWM module of the LPC2128 microcontroller and control the brightness of an LED.
4	Implement interrupt-driven programming to toggle an LED in response to a button press.
5	Establish UART communication between the LPC2128 microcontroller and a computer, and transmit and receive data.
6	Implement timer-based applications such as generating delays and periodic interrupts.
7	Interface an external EEPROM memory with the LPC2128 microcontroller and store and retrieve data using I2C
8	Demonstrate real-time clock (RTC) interfacing and time display.
9	Configure PLL to set system clock and verify timing accuracy.
10	Program and test the functionality of the Watchdog Timer.
11	**Open ended experiment:** Interface a 8-digit seven segment (using MAX7219 driver) display with LPC2128 using SPI protocol.

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	ARM LPC2148 Based Embedded Systems: Concepts, Designs, and Programming	Sumit Ahuja	Khanna Publishers, 1st Edition, 2018
2	Embedded Systems: Using Assembly and C	Muhammad Ali Mazidi, Shujen Chen, Sepehr Naimi	Pearson Education, 1st Edition, 2009

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers	Jonathan W. Valvano	CreateSpace, 1st Edition, 2012
2	ARM Assembly Language: Fundamentals and Techniques	William Hohl, Christopher Hinds	CRC Press, 2nd Edition, 2014
3	Programming Embedded Systems in C and C++	Michael Barr, Anthony Massa	O'Reilly Media, 2nd Edition, 2006

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the architecture and features of microcontrollers.
CO2	**Apply** embedded C programming for interfacing devices.
CO3	**Design** embedded applications using timers, ADCs, and communication modules.
CO4	**Demonstrate** the use of real-time clock, PLL, and watchdog timer.
CO5	**Develop** embedded mini-projects using peripheral modules.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1		1									1	
CO2		2			2							2	
CO3		2	3	2	2							2	
CO4		2	2	3								2	
CO5		3	3	2	3				2	2	2	3	

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks			
Sl. No.	**Components**	**Marks Conducted for**	**40% Min Marks in each component to write SEE**
1	Periodic Lab Assessment	30	12
2	Lab CIE	20	8
	Total CIE	50	20
Rubrics for Periodic Lab Assessment: Attendance (5M), Lab record(10M), Conduction of Experiments(10M) and Viva((5M)-**Total 30M.** **Lab CIE**: Write-up(5M), Conduction/Execution/Demonstration(10M) and Viva(5M)**-Total 20M.**			
Semester End Examination (SEE): Max 50 Marks, Duration: 3 Hrs. **Rubrics for Lab Examination:** Write-up(8M), Conduction/Execution/Demonstration(35M) and Viva(7M)-**Total 50M.** **Minimum passing Marks: 40% of Max Marks.**			

Department: Electronics and Communication Engineering			Semester:	5
Subject: Skill Development-II (Aptitude Skills)				
Subject Code:	22SK508	L – T – P – S:	14-0-0-16 (In Hrs)	
			Credits:	1

Sl. No	Course Objectives
1	To **equip** students with quantitative aptitude skills required for competitive exams and placement tests.
2	To **develop** the ability to interpret, analyze, and solve data-driven problems using arithmetic and visual methods.
3	To **enhance** problem-solving strategies in areas such as probability, permutations, combinations, and data sufficiency.
4	To **apply** mathematical and logical concepts in real-world problem-solving scenarios like time, work, and distance.

Module	Description	Hrs
I	**Logical aptitude** - Syllogism, Venn-diagram method, three statement syllogism, deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. **Linear seating arrangement -** Single or double rows facing each other or away from each other in the same direction. **Circular seating arrangement –** Uni- & bi-directional problems on circular, square, rectangular, hexagonal tables. **Coding decoding:** Letter coding, number coding, symbol coding. **Crypt arithmetic**: Basic concepts, addition, subtraction, multiplication of coded alphabets, types of cryptarithm, Clocks and Calendar. **Reasoning –** Verbal - blood relation, sense of direction, arithmetic & alphabet. non- verbal reasoning - visual sequence, visual analogy and classification. analytical reasoning - single & multiple comparisons, linear sequencing.	**3**

II	**Permutation and Combination**: Understanding the difference between the permutation and combination, Rules of counting: rule of addition, rule of multiplication, factorial function, concept of step arrangement, permutation of things when some of them are identical, concept of 2n, arrangement in a circle. **Probability**: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.	**3**
III	**Number System:** Divisibility & remainder, multiples & factors, integers, LCM & HCF, complete a number series, find the missing term and wrong term. **Simplification:** BODMAS rule, approximation, decimals, fractions, surds & indices. **Percentage:** Calculation-oriented basic percentage, profit and loss, successive selling type, discount & MP, dishonest dealings, partnerships. **Interest:** Simple interest, compound interest, mixed interest, instalments. **Data interpretation**: Approach to interpretation, simple arithmetic, rules for comparing fractions, calculating (approximation) fractions, short cut ways to find the percentages, classification of data - tables, bar graph, line graph, cumulative bar graph, pie graph, combination of graphs, combination of table and graphs.	**3**
IV	**Averages and allegations mixtures**: Average: relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. Allegation method: a situation where allegation technique, general representation of allegations, the straight line approach, application of weighted average and allegation method in problems involving mixtures. Application of allegation on situations other than mixtures problems. **Data sufficiency**: Questions based on - quantitative aptitude, reasoning aptitude, puzzles.	**3**
V	**Ratio and proportion:** Simple ratios, compound ratios, comprehend and dividend, direct & indirect proportions, problems on ages, mixtures & allegation. **Speed, time and distance:** relative speed, average speed, problems on train, boat & stream. **Time and work:** Work efficiency, work & wages, pipes &	**2**

	cisterns.	

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	How to Prepare for Logical Reasoning for CAT" by Arun Sharma	Arun Sharma	ISBN-10: 9352602280
2	A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal	R.S. Aggarwal	ISBN-10: 8121924987

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal	R.S. Aggarwal	ISBN-10: 9352534026
2	Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha	Nishit K. Sinha	ISBN-10: 933922269X

Course Outcomes:

Course outcome	Descriptions
CO1	**Apply** logical reasoning techniques to solve syllogisms, puzzles, seating arrangements, and coding-decoding problems.
CO2	**Solve** permutation, combination, and probability problems.
CO3	**Demonstrate** proficiency in number systems, percentages, interests, profit & loss, and data interpretation.
CO4	**Analyze** problems involving averages, mixtures, allegations, and data sufficiency using logical and quantitative methods.
CO5	**Apply** concepts of ratio, proportion, time, speed, distance, and work to solve complex real-life aptitude problems.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2							
CO2	3	3	2			2							
CO3	3	2				2							
CO4	3	3	2			2							
CO5	3	3	2			2							

Course Assessment and Evaluation:

Sl. No.	Components		Duration (min)	Marks Conducted for	Min Marks To pass the Course
1	Theory- Internal Assessment	IA-1	90	50	40
		IA-2	90	50	
	Total CIE			100	40
IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module					

6th Semester B.E. **Academic year 2026-27**

Sl. No.	Course Code		Course Title	Teaching Dept.	L	T	P	S	Total	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	22EC601	Microwave Theory and Antennas	EC	42	-	-	48	90	3	50	50	100	3
2	PC	22EC602	Digital Communication	EC	42	-	28	50	120	4	50	50	100	3
3	PC	22EC603	Computer Communication Networks	EC	42	-	28	50	120	4	50	50	100	3
4	PE	22EC6PE4x	Professional Elective-II	EC	42	-	-	48	90	3	50	50	100	3
5	OE	22EC6OE5x	Open Elective-II	EC	42	-	-	48	90	3	50	50	100	3
6	PC	22xx66x	Online Course: NPTEL/MOOC/SWAYAM 22NP661-NPTEL, 22MC662-MOOC, 22SW663-SWAYAM	-	-	-	-	60	60	2		-	100	-
7	PW	22ECMP607	Mini Project	EC	-	-	42	18	60	2	50	50	100	3
8	HS	22SK608	Placement Training	T&P	-	-	28	2	30	1	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, S: Student academic activity, SEE: Semester End Examination				**Total**	**210**	**-**	**126**	**324**	**660**	**22**	**350**	**300**	**750**	**-**

Professional Elective - II		Open Elective - II	
22EC6PE41	Machine Learning	22EC6OE51	Introduction to Embedded System
22EC6PE42	Analog and mixed signal VLSI Design	22EC6OE52	Pattern Recognition
22EC6PE43	Information security and Cyber space	22EC6OE53	Robotics
22EC6PE44	Real time operating systems using QNX		

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Microwave Theory and Antennas				
Subject Code:	**22EC601**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the basic concept of microwave devices.
2	**Learn** the representation of microwave networks and **analyse** the port details of microwave devices.
3	**Acquire** the knowledge of antenna basics and types of antennas.
4	**Study** the applications of microwaves and antennas.

Module	**Description**	**Hrs**
I	**Microwave vacuum tubes:** Introduction, reflex klystron oscillator, mechanisms of oscillations, modes of oscillations, travelling wave tube amplifier, magnetron oscillator (qualitative discussion, construction, operation). Microwave solid state devices: PIN diode and its applications, Gunn diode (theory of operation) (Text 2: 9.1 to 9.4, 10.2.6, 10.3)	**9**
II	**Microwaves:** Introduction, transmission lines (end equations only for reflection coefficient and transmission coefficient, standing wave and standing wave ratio), smith chart. **Microwave network theory and passive devices:** Introduction, scattering or S-matrix representation of multiport network, properties of S-parameters. **Microwave passive components:** Coaxial cables, coaxial line to waveguide adapters, attenuators, phase shifters (dielectric and precision dielectric phase shifters) waveguide tees, magic tee. (Text 1: 1.1, Text 2: 6.1, 6.3, 6.3.1, 6.4.1, 6.4.11, 6.4.14, 6.4.15, 6.4.16)	**9**
III	**Introduction to ferromagnetic insert and component**:	

	Circulators, isolators and directional couplers. **Antenna basics:** Introduction, basic antenna parameters, patterns, beam area, radiation intensity, beam efficiency, directivity and gain, antenna apertures, effective height, radio communication link, antenna field zones. (Text 2: 6.4.17 & 6.4.18, Text 3: 2.1 to 2.7, 2.9 to 2.11 & 2.13)	**8**
IV	**Point sources and arrays:** Introduction, point sources, power patterns, power theorem, radiation intensity, arrays of two isotropic point sources, linear arrays of n isotropic point sources of equal amplitude and spacing. **Electric dipoles:** Introduction, short electric dipole, radiation resistance of a short electric dipole. (Text 3: 5.1 – 5.5, 5.9, 5.13,6.1, 6.2 & 6.4)	**8**
V	**Antenna types:** Introduction, the helix geometry, helix modes, patch or micro strip antenna, horn antenna, parabolic reflector. (Text 3: 7.19, 8.3, 8.4, 8.5, 8.8, 9.7,14.2, 14.3, 14.4) **Applications of microwaves:** Introduction, microwave radar systems, the radar range equation, duplexer, pulsed Radar, CW Radar (Text 2: 11.2, 11.2.1, 11.2.2, 11.2.4)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Microwave devices and circuits	Samuel Y Liao	Pearson , 3rd Edition, 2008
2	Microwave Engineering	Annapurna das and Sisir K das	McGraw Hill Education, 3rd Edition, 2015
3	Antennas and Wave Propagation	John D Kraus	McGraw Hill Education, 4th Edition, 2010

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Microwave Engineering	David M Pozar	John wiley & Sons, 4th edition, 2012.

2	Microwave and Radar Engineering	M Kulkarni	Umesh Publications, 4th edition, 2009.
3	Antennas and Wave Propagation	K.D. Prasad	Satya Prakashan, 2021st edition, 2021.

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the characteristics and operation of active devices.
CO2	**Apply** the knowledge of S-parameter properties for measuring the performance of microwave networks.
CO3	**Interpret** the operation of passive devices, and **construct** the s-parameters.
CO4	**Analyze** the design parameters of an antenna, arrays of antennas and the performance of antenna types.
CO5	**Identify** the applications of microwaves and antennas in communication systems.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2												
CO2	3	2			1								
CO3	2	1			1								
CO4	2	2									2		
CO5		2									1		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination (SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Digital Communication				
Subject Code:	**22EC602**	**L – T – P – S:**	**42-0-28-50 (In Hrs)**	
			Credits:	**4**

Sl. No.	Course Objectives
1	**Understand** the basics of information theory.
2	**Study** the various waveform coding schemes.
3	**Learn** the various baseband transmission schemes, understand the various band pass signaling schemes and various spread spectrum techniques.
4	**Acquire** the fundamental knowledge of channel coding.

Module	Description	Hrs
I	**Information theory:** Discrete memory less source, information, entropy, mutual information - discrete memory less channels – binary symmetric channel, channel capacity - Hartley - Shannon law - source coding theorem - Huffman codes. (Text 1: 2.1 to 2.9)	8
II	**Introduction and waveform coding techniques:** Introduction, Basic signal processing operations in digital communication, PCM, Quantization noise and SNR, Robust quantization, DPCM, DM, ADM, Coding speech at low bit rates, ADPCM, Adaptive sub-band coding. (Text 1: 1.2, 5.1 to 5.8)	9
III	**Base-band shaping for data transmission:** base-band shaping for data transmission, discrete PAM signals, power spectra of discrete PAM signals, ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission. (Text 1: 6.1 to 6.8)	9
IV	**Digital modulation techniques:** Digital modulation formats, coherent binary modulation techniques, coherent quadrature	8

	modulation techniques, non-coherent binary modulation techniques. (Text1: 7.1 to 7.4)	
V	**Spread spectrum modulation:**Pseudo noise sequences, Notion of spread spectrum, direct sequence spread spectrum with coherent binary PSK, frequency hop spread spectrum, applications. **Error control coding:** Channel coding theorem - linear block codes - Hamming codes. (Text 1:9.1 to 9.3, 9.6, 9.7, 8.3 to 8.4)	8

LAB CONTENT:

Sl. No.	Experiment Description
	PART-A: Experiment Description
1	Study the digital modulation and demodulation using Amplitude Shift Keying technique.
2	Study the digital modulation and demodulation using Frequency Shift Keying technique.
3	Study the digital modulation and demodulation using Phase Shift Keying technique.
4	Study the digital modulation and demodulation using Differential Phase Shift Keying technique.
5	Verification of sampling theorem using Flat-Top Sampling.
6	Study of mode curves of Reflex Klystron oscillator and determine a) Electronic tuning range b) Electronic tuning sensitivity.
7	Measurement of losses in a given optical fiber.
8	NA of a given optical fiber and Numerical aperture.
	PART-B: Using simulation tool
8	Matlab code for generation of line codes
9	Matlab code for generation of DPSK waveforms
10	Matlab code for Pulse code Modulation & De-modulation
11	Matlab code to determine i) Entropy ii)Joint Entropy iii)Conditional Entropy

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital communication systems	Simon Haykin	2013. John wiley, ISBN: 81-265-0824-8
2	Digital communications	John G Proakis and Masoud Salehi	Mcgraw hill, fifth edition, 2014. ISBN: 978-0-07-295716-7

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Digital and analog communication systems	K.Sam Shanmugam	John Wiley, 2012. ISBN: 978-0-47-103090-4
2	Analog and Digital Communications.	H P Hsu	TMH 2017 ISBN: 978-0070306363
3	Principles of digital communication.	Taub and Schilling	Tata Mcgraw-hill,28th reprint,2017. ISBN: 978-0-07-064811-1
4	Digital communications.	Bernard Sklar	Pearson education, 2009.ISBN: 81-7808-373-6

Course Outcomes:

Course outcome	Descriptions
CO1	**Implement** and **interpret** various waveform coding techniques and its variants in applications like speech coding at low bit rates.
CO2	**Analyze** the characteristics of baseband signaling schemes and their performance.
CO3	**Illustrate** the band pass signaling schemes and spread spectrum techniques.
CO4	**Analyze** the source coding and error control coding techniques.
CO5	**Describe** the various spread spectrum techniques.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2								1			
CO2	2	3	1							1		2	
CO3	2	1	2	1						1		1	
CO4	1	1	3		2					1			
CO5	3	2	1										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No	**Components**		**Duration(min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	15	12
		IA-2	90	50	15	
2	Periodic Lab Assessment		-	30	10	4
3	Lab CIE		-	20	5	2
4	One Open Ended Experiment/ Project		-	10	5	2
	Total CIE			**150**	**50**	**20**

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module
Rubrics for Periodic Lab Assessment: Attendance (5M), Lab record (10 M), Conduction of Experiments(10M) and Viva(5M)-**Total 30M**
Lab CIE: Write-up(5M), Conduction/Execution/Demonstration(10M) and Viva(5M)-**Total 20M**
One Open Ended Experiment/ Project: Experimental / project Design (4 marks), Execution/demonstration (3 marks) and Analysis/Viva (3 marks)- **Total 10M**

Semester End Examination(SEE) : **Max 100 Marks,** Duration: 3 Hrs
The question paper shall contain 10 full questions (20 marks each)**,** with 2 questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice**.** Each question may have a maximum of 4 sub-divisions**.**
Minimum passing Marks : 40% of Max Marks

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Computer Communication Networks				
Subject Code:	**22EC603**	**L – T – P – S:**	**42-0-28-50**	**(In Hrs)**
			Credits:	**4**

Sl. No	**Course Objectives**
1	**Familiarize** with the fundamentals of communication networks, network topologies and network model (TCP/IP) for data communications.
2	**Learn** framing techniques, flow control, error control mechanisms and Data link, MAC protocols.
3	**Understand** Network layer services, Packet formats, Routing protocols and IP addressing.
4	**Outline** the Transport layer Services, TCP/UDP Packet formats & Protocols.

Module	**Description**	**Hrs**
I	**Data communications:** Introduction, components, representations, data flow, Networks: Network criteria, physical structures, Network types: LAN, WAN, switching, the internet, accessing the internet. **Network models:** TCP/IP protocol suite: Layered architecture, The OSI model: OSI versus TCP/IP. **Data-link layer:** Introduction, nodes and links, services, categories of link, two sub layers, Link layer addressing: ARP. Data Link Control (DLC) services: Framing, flow and error control, simple protocol, stop and wait protocol. (Text 1: 1.1 - 1.1.3, 1.2, 1.2 - 1.2.2, 1.3 - 1.3.5, 2.2 - 2.2.3, 2.3, 2.3.1, 9.1 - 9.1.4, 9.2 - 9.2.2, 11.1 - 11.1.2, 11.2.1, 11.2.2)	9
II	**Media Access Control:** Introduction, Random access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled access: reservation, polling, token passing. Channelization: FDMA, TDMA, CDMA.	9

	Wired and Wireless LANs: IEEE project 802, ethernet evolution, Standard ethernet: Characteristics, efficiency, implementation. **Wireless LANs:** Characteristics, access control, IEEE 802.11 project: Architecture, MAC sub layer, Bluetooth: Architecture. (Text 1: 12.1 - 12.1.4, 12.2.1 - 12.2.3, 12.3 - 12.3.3, 13.1.1, 13.1.2, 13.2, 13.2.1, 13.2.4, 13.2.5, 15.1.2, 15.1.3, 15.2, 15.2.1, 15.2.2, 15.3, 15.3.1)	
III	**Connecting Devices:** Introduction, hubs, link layer switches, routers, virtual LANs, membership, configuration. **Network Layer:** Introduction, network layer services, packetizing, routing and forwarding, packet switching, datagram approach, virtual circuit approach. **IPV4 Addresses:** Address space, classful addressing, classless addressing, network address translation. (Text 1: 17.1.1 - 17.1.3, 17.2, 18.1 - 18.1.2, 18.2.1, 18.2.2, 18.4 - 18.4.3, 18.4.5)	8
IV	**Network Layer Protocols:** Introduction, internet protocol (IP): datagram format, security of IPv4 datagram, Mobile IP: Addressing, agents, three phases, inefficiency in mobile IP. **Next generation IP:** IPV6 addressing, representation, address space, IPV6 protocol- packet format, transition from IPv4 to IPv6, strategies. **Uni-cast routing:** Routing algorithms: Distance vector routing, link state routing. (Text 1:19.1, 19.1.1, 19.1.4, 19.3 - 19.3.4, 22.1 - 22.1.2, 22.2, 22.2.1, 22.4, 22.4.1 ,20.2, 20.2.1, 20.2.2)	8
V	**Transport layer:** Transport layer services, protocols, transport layer protocols: go-back-n protocol, selective repeat protocol. **Transport layer protocols in the internet:** User Datagram Protocol (UDP): User datagram, UDP services, UDP applications, Transmission Control Protocol: TCP services, TCP features, TCP segment, TCP connection. (Text 1: 23.1.1, 23.2, 23.2.3, 23.2.4 ,24.2, 24.2.1, to 24.2.3, 24.3, 24.3.1 - 24.3.4)	8

Lab Content:

Sl. No.	Experiment Description
1	Implement bit stuffing & de-stuffing algorithm in C-program.
2	Implement character stuffing & de-stuffing algorithm in C-program.
3	Implement encryption and decryption algorithms in C-program.
4	Implement stop and wait protocol, sliding window protocol in C-program.
PART-B : Experiments using simulation tools	
5	Simulate a four-node point to point network with duplex links between them and set the queue size to vary bandwidth and to find the number of packets dropped using network simulator.
6	Simulate different types of internet traffic such as FTP and TELNET over a network to analyze the throughput using network simulator.
7	Simulate ethernet LAN using n nodes and set multiple traffic nodes to determine collision across different node using network simulator.
8	Test and verify network configurations using cisco packet tracer.
9	Perform an Initial Router configuration cisco packet tracer.
10	Perform OSPF configuration using cisco packet tracer.

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Data Communication and Networking	B Forouzan	McGraw Hill,2013, 5th Edition

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Computer Networks	James F.Kurose, Keith W.Ross	Pearson Edu., 2nd Edition, 2003
2	Introduction to Data Communication and Networking	Wayne Tomasi	Pearson Edu., 2007
3	Computer Networks	V.S.	Technical publications,

		Bagadandl. A. Dotre	2nd edition, 2009.
4	Computer networks	Andrew S.Tenenbaum	Pearson Prentice hall, 2010, 4th Edition

Course Outcomes:

Course outcome	Descriptions
CO1	**Discuss** the requirements of data communications and functions of layers in the TCP/IP network model for data communications.
CO2	**Interpret** and **illustrate** services and protocols of different layers.
CO3	**Design** and **simulate** wired, wireless LAN technologies and connecting devices.
CO4	**Analyze** different addressing mechanisms of data link layer and network layer.
CO5	**Compare** the services and applications of routing algorithms and transport layer protocols.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2												
CO2	2	2	2		2				1				
CO3	2	2	1		2				1				
CO4	2	1	1		2				1				
CO5		2	1		2								

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No	**Components**		**Duration(min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	15	12
		IA-2	90	50	15	
2	Periodic Lab Assessment		-	30	10	4
3	Lab CIE		-	20	5	2
4	One Open Ended Experiment/ Project		-	10	5	2
	Total CIE			**150**	**50**	**20**

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module
Rubrics for Periodic Lab Assessment: Attendance (5M), Lab record (10 M), Conduction of Experiments(10M) and Viva(5M)-**Total 30M**
Lab CIE: Write-up(5M), Conduction/Execution/Demonstration(10M) and Viva(5M)-**Total 20M**
One Open Ended Experiment/ Project: Experimental / project Design (4 marks), Execution/demonstration (3 marks) and Analysis/Viva (3 marks)- **Total 10M**

Semester End Examination(SEE) : **Max 100 Marks,** Duration: 3 Hrs
The question paper shall contain 10 full questions (20 marks each)**,** with 2 questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice**.** Each question may have a maximum of 4 sub-divisions**.**
Minimum passing Marks : 40% of Max Marks

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Machine Learning				
Subject Code:	**22EC6PE41**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the spectrum of machine learning algorithms with a sound mathematical background.
2	**Outline** supervised learning methods and its evaluation metrics.
3	**Learn** the unsupervised learning methods and their evaluation metrics.
4	**Acquire** the knowledge of Bayesian techniques for solving problems in machine learning.

Module	**Description**	**Hrs**
I	**Introduction to machine learning**: Machine learning landscape: Purpose of machine learning, examples of applications, types of ML, main challenges of ML. Testing & validating end to end machine learning project: Working with real data, look at the big picture, get the data, discover, and visualize the data, prepare the data, select, and train the model, fine tune your model. (Text 1: Chapter 1 & 2)	**9**
II	**Supervised learning**: Linear regression, multiple linear regression, logistic regression, K-nearest neighbors. Decision trees: ID3, classification and regression trees. Support vector machines: Linear and non-linear, kernel functions. (Text 1: Chapter 4)	**9**
III	**Design and analysis of machine learning experiments** Guidelines for machine learning experiments, cross validation (CV) and re-sampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm, and comparing two classification algorithms – t test,	**8**

	McNemar's test, K-fold CV paired t test. (Text 2: Chapter 19)	
IV	**Ensemble techniques and unsupervised learning:** Combining multiple learners: model combination schemes, voting, ensemble Learning - bagging, boosting, stacking, Unsupervised learning: Introduction to clustering, K-means clustering, dimensionality reduction-principal component analysis. (Text 1: Chapter 7)	**8**
V	**Classifying with probabilistic models**: Bayes theorem, concept learning, maximum likelihood and least squared error hypothesis, minimum description length principle, Bayes optimal classifier, Naïve Bayes classifier, Bayesian belief network, EM algorithm. (Text 3: 6.1 - 6.4, 6.6, 6.7, 6.9, 6.11, 6.12)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Hands-on Machine Learning with Scikit-Learn &TensorFlow	Aurelien Geron	2nd Edition, O'Reilly, 2019
2	Introduction to Machine Learning	Ethem Alpaydin	4th Edition, MIT Press 2020
3	Machine Learning	Tom Mitchell	3 rd Edition, McGraw Hill 1997

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Pattern Recognition and Machine Learning Christopher M. Bishop 1 st Springer 2006	Pattern Recognition and Machine Learning Christopher M. Bishop 1 st	Pattern Recognition and Machine Learning Christopher M. Bishop 1 st Springer 2006

		Springer 2006	

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** machine learning techniques in computing systems.
CO2	**Apply** Supervised learning algorithms to do prediction and classification.
CO3	**Interpret** evaluation techniques and statistical tests used for assessing classifier performance.
CO4	**Illustrate** unsupervised learning algorithms to learn patterns from given training set of unlabeled data points.
CO5	**Analyze** the Bayesian techniques and the learning rules.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2		2	3	2							1		
CO3	2												
CO4		2	3	2							1		
CO5	2	2											

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks					
Sl. No.	**Components**	**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**

1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	6
Subject: Analog and Mixed Signal VLSI Design				
Subject Code:	**22ECPE642**	**L – T – P – S:**	**42-0-0-48**	**(In Hrs)**
			Credits:	**3**

Sl. No	Course Objectives
1	**Learn** the layout issues of analog and digital system design.
2	**Study** different architectures of data converters and their SNRs with pros and cons.
3	**Understand** the fabrication steps at submicron technology.
4	**Acquire** the knowledge of single stage amplifiers using MOSFET.

Module	Description	Hrs
I	**DAC fundamentals & architectures**: Introduction, DAC specifications, mixed signal layout issues. DAC architectures: Resistors string, R-2R ladder networks, charge scaling DAC (excluding split array), cyclic DAC, pipeline DAC, problems on all types of DAC. (Text 1: 28.4, 28.6, 29.1.2, 29.1.3, 29.1.5, 29.1.6, 29.1.7)	**9**
II	**ADC fundamentals & architectures**: Introduction, analog versus digital discrete time signals, sample and hold characteristics, ADC specifications, ADC architectures: Flash ADC, 2-step flash ADC, pipeline ADC, integrating ADC, successive approximation ADC (excluding charge redistribution SAR), and problems on all types of ADC. (Text 1: 28.1, 28.3, 28.5, 29.2.1, 29.2.2, 29.2.3, 29.2.4, 29.2.5)	**9**
III	**Sampling and aliasing**: Impulse sampling, quantization noise, spectral density of quantization noise. Data converter SNR: Improving SNR using averaging (Excluding jitter & averaging onwards), decimating filters for ADCs (Excluding decimating without averaging onwards), and interpolating filters for DAC. (Text 2: 30.1.1, 30.3.2, 31.1.1, 31.1.2, 31.2.1, 31.2.2, 31.2.3)	**8**

IV	**Sub-micron CMOS circuit design**: Submicron capacitors and resistors. Digital circuit design: MOSFET switch (up to bidirectional switches), delay, adder elements. Analog circuits design: MOSFET biasing (up to MOSFET transition frequency). (Text 2: 33.1.2, 33.2.1, 33.2.2, 33.2.3, 33.3.1)	**8**
V	**Single stage amplifiers:** Basic concepts, common source amplifier with resistive load, diode connected load, source follower, common gate amplifier. (Only voltage gain expressions using large signal and small signal models). (Text 3: 3.1, 3.2.1, 3.2.2, 3.3, 3.4)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	CMOS Circuit Design, Layout, Simulation	R. Jacob Baker	John Wiley & Sons, INC. 4th Edition, 2019.
2	CMOS Mixed Signal Circuit Design	R. Jacob Baker	Volume –II, John Wiley & Sons, INC. 2009.
3	Design of Analog CMOS Integrated Circuits	B Razavi	Tata McGraw Hill, 2009.

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	CMOS Analog and Mixed-Signal Circuit Design	Arjuna Marzuki	CRC Press 1st Edition, 2020.
2	CMOS Circuit Design, Layout and Simulation	R. Jacob Baker, Harry W. Li, David E Boyce	IEEE Press, 2002.
3	VLSI Design Techniques for Analog and Digital Circuits	Randall Geiger, Phillip E. Allen, Noel Stradder	Tata McGraw Hill, 2010.

Course Outcomes:

Course outcome	Descriptions
CO1	**Analyze** the layout issue of mixed signal systems and different Digital to Analog Converter architectures.
CO2	**Interpret** the various specifications and architectures of analog to digital converters.
CO3	**Apply** the different techniques to improve the SNR.
CO4	**Describe** the fabrication process of passive components at submicron level.
CO5	**Design** of single stage amplifiers using signal models.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	3											
CO2	1	3											
CO3		2											
CO4	1												
CO5			2										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	

2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each)**,** with **2** questions from each of the 5 Modules**,** ensuring 100% syllabus coverage**.** Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks : 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	6
Subject: Information Security and Cyber Space				
Subject Code:	22EC6PE43	L – T – P – S:	42-0-0-48	(In Hrs)
			Credits:	3

Sl. No.	Course Objectives
1	**Understand** the Information Security goals, and classical encryption techniques.
2	**Learn** the Symmetric and Asymmetric cryptography techniques in different domains and applications.
3	**Study** the need for cyberspace and cyber security.
4	**Outline** different message authentication codes, hash functions and cyberspace terminologies.

Module	Description	Hrs
I	**Classical encryption techniques:** Introduction, cyber-attacks, defense strategies and techniques, mathematical background for cryptography - modulo arithmetic's a model of network security. **Classical encryption techniques:** Symmetric cipher model, substitution techniques, transposition techniques. (Text 1: 1.3, 1.4, 1.5, 1.6, 2.1 to 2.5, Text 2: 1.1-1.5)	**9**
II	**Block ciphers:** Introduction, public key cryptography and other public key cryptosystem, block cipher principles, The Data Encryption Standard, a DES example, strength of DES, block Cipher modes of operation. **Public-key cryptography and RSA:** Principles of public-key cryptosystems, The RSA algorithm, Diffie- Hellman key exchange. (Text 1: 3.1 to 3.5, 9.1, 9.2, 10.1)	**9**
III	**Message authentication and hash functions:** Introduction, cryptographic hash functions: applications of cryptographic hash functions, two simple hash functions. message	**8**

	authentication codes: authentication requirements, security of mac's. Digital Signatures: digital signatures, digital signature standard. (Text 1: 11.1, 11.2, 12.1 to 12.4, 13.1 & 13.4)	
IV	**Introduction to cyber space:** Fundamental notions of copyright law, need to protect data in cyberspace, types of data, legal framework of data protection, it act aim and objectives, scope of the act, secure electronic records and secure digital signatures, regulation of certifying authorities: digital signature certificates. (Text 2:1.1 – 1.5, 7.1 – 7.3)	**8**
V	**IP protection issues in cyberspace:** Copyright issues in cyberspace, copyright infringement in digital environment-software piracy, linking, framing, caching, meta tagging, legal protection of copyright in international framework-WCT, WPPT, TRIPS. Indian legal protection of copyright in cyberspace & concept of DRM. **Emerging issues of cyberspace:** cloud computing and internet of things. (Text 2: 12.1 – 12.3 and 15.1 – 15.3)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Cryptography and Network Security Principles and Practice	William Stallings	Pearson Education Inc., 6thEdition, 2014
2	Internet Law-Regulating Cyberspace a nd Emerging Technologies	Rodney D Ryder & Nikhil Naren	Bloomsbury ,2020

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Cyber Law simplified	Vivek Sood	Mc-Graw Hill, 11th reprint , 2013

2	Cryptography and Network Security	Behrouz A. Forouzan and DebdeepMukhopadhyay	McGrawHill Education, 2nd Edition, 2014
3	Legal Desire International Journal on Law	Aparajita Singh1 Rajini B	Vol. 9 Edition 28 ISSN: 2347 - 3525

Course Outcomes:

Course outcome	Descriptions
CO1	**Interpret** the need for enforcing security policies, standards and practices from intruders.
CO2	**Summarize** the importance of cryptographic algorithms.
CO3	**Describe** different cryptographic techniques for cyber security.
CO4	**Evaluate** different data protection regime and privacy aspects of cyberspace.
CO5	**Analyze** Information protection issues in Cyberspace.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										1	
CO2		2	3	1									
CO3		1	2	1									
CO4		1		1									
CO5		1	2	1									2

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks					
Sl.	**Components**	**Duration**	**Marks**	**Marks**	**40% Min Marks**

Syllabus for the Academic Year 2026-27

No.			(min)	Conducted for	reduced to	in each component to write SEE
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examinatio(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	6
Subject: Real Time Operating Systems using QNX				
Subject Code:	22EC6PE44	L – T – P – S:	42-0-0-48 (In Hrs)	
			Credits:	3

Sl. No.	Course Objectives
1	**Understand** the architecture and core concepts of the QNX RTOS.
2	**Learn** to develop and debug applications using the QNX Momentics IDE.
3	**Acquire** the knowledge of process and thread management, including synchronization techniques.
4	**Study** QNX boot/OS images for embedded system applications.

Module	Description	Hrs
I	**Introduction to QNX OS architecture:** Overview of QNX OS architecture: microkernel, process manager, and standards. Protected address spaces, process/thread model, and scheduling. Introduction to inter-process communication (IPC) and synchronization. Resource managers and shared objects. (Text 1: 1.1 to 1.6, 2.1 to 2.4)	9
II	**Processes, threads, and synchronization:** Process management: creation, termination, and memory protection, Thread management: creation, termination, and synchronization, Synchronization techniques: mutexes, semaphores, and condition variables, Hands-on exercises: process/thread creation and synchronization. (Text 1: 3.1 to 3.7, 4.1 to 4.4)	8
III	**Inter-process communication (IPC):** Overview of IPC methods in QNX: message passing, pulses, and shared memory, comparing IPC methods: advantages and disadvantages, practical implementation of IPC in QNX, hands-	9

	on exercises: message passing and shared memory. (Text 1: 5.1 to 5.6, 6.1 to 6.4)	
IV	**Hardware programming and timing:** Hardware access methods: IO-mapped and memory-mapped IO, interrupt handling and DMA-safe memory allocation, timing architecture: periodic timing, one-shot timing, and timeouts, hands-on exercises: interrupt handling and timing mechanisms. (Text 1: 7.1 to 7.7, 8.1 to 8.3)	7
V	**Building and configuring QNX boot/OS images:** Overview of QNX boot/OS image structure, components of a boot image: startup code, kernel, drivers, and scripts, building and loading boot images onto target hardware, Introduction to resource managers and their implementation. (Text 2)	9

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Real-Time Concepts for Embedded Systems	Qing Li and Caroline Yao	2nd Edition, CMP Books, 2011.
2	QNX Neutrino RTOS System Architecture Guide	---------	QNX Software Systems Ltd, Latest Edition.

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Embedded and Real-Time Operating Systems	K.V.K.K. Prasad	Dreamtech Press, 2005.
2	Real-Time Systems: Design Principles for Distributed Embedded Applications	Hermann Kopetz	2nd Edition, Springer, 2011.

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the architecture, services, and microkernel-based design of QNX RTOS. (L2)
CO2	**Apply** process/thread management and synchronization techniques in real-time systems. (L3)
CO3	**Implement** inter-process communication mechanisms using message passing, pulses, and shared memory. (L3)
CO4	**Develop** real-time applications involving hardware access, interrupts, timing mechanisms, and device interfaces. (L3)
CO5	**Analyse** QNX boot/OS images and **apply** POSIX-compliant programming concepts for embedded systems.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2		3										2	
CO3		2	3		1							1	
CO4	2	2	2	3	2							2	
CO5	2	2		3								2	

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal	IA-1	90	50	20	16

	Assessment	IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination (SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering			Semester:	6
Subject: Introduction to Embedded Systems				
Subject Code:	**22EC6OE51**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	Course Objectives
1	**Understand** the architecture and features of microprocessors and micro controllers.
2	**Learn** the embedded system design process and design metrics.
3	**Study** of single-purpose processors and their interfacing components.
4	**Introduce** the concepts of interrupts and real-time operating systems (RTOS).

Module	Description	Hrs
I	**Microprocessors and microcontrollers:** Introduction to microprocessor and micro controllers, RISC and CISC CPU architecture Harvard and Von Neumann Architectures, general features and architecture of micro controllers. (Text 1: 2.1 – 2.7)	**9**
II	**Introduction to embedded system design**: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them, processor technology, design technology. (Text 2: 1.1 – 1.5)	**9**
III	**Single purpose processors:** Timers, countersuit, PWM, LCD controllers, stepper motor controllers, A to D converters examples problems. (Text 2: 4.1 – 4.8, 6.1 – 6.8)	**8**
IV	**Interrupts:** Basics, shared data problem, interrupt latency, survey of software architecture, round robin, round robin with interrupts, function queues scheduling. (Text 3: 4.1 – 4.4, 5.1 – 5.4)	**8**

V	**Introduction to RTOS:** Tasks, states, data, semaphores, shared data, more operating system services, message queues, mail boxes, timers, events. (Text 2: 6.1 – 6.3, 7.1 – 7.3)	**8**

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	"The 8051 Microcontroller and Embedded Systems"	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay.	Pearson Education, Second Edition, 2014.
2	Embedded System Design: A Unified Hardware/Software Introduction.	Frank Vahid, Tony Givargis	Pearson Education, Second Edition, 2014 ISBN:9971- 51-405-2
3	An Embedded software Primer	David E. Simon	CISCO Press, 2017. ISBN:81-7758-154-62006

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Embedded Systems: Architecture and Programming	Raj Kamal,	TMH. 2008 Education Asia / PHI Indian Reprint 2002
2	Introduction to Embedded Systems	Shibu K. V	McGraw-Hill Education(INDI A) Private limited 2012
3	Embedded Systems: A Contemporary Design Tool	James K	John Weily India Pvt. Ltd2014

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the architecture and features of microprocessors and microcontrollers.
CO2	**Differentiate** between RISC and CISC, Harvard and Von Neumann architectures.
CO3	**Analyze** the challenges in embedded system design and optimization techniques.
CO4	**Illustrate** the working of timers, counters, LCDs, PWM, stepper motor controllers and ADCs.
CO5	**Apply** interrupt handling mechanisms and RTOS concepts such as semaphores, queues, and scheduling.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2	3	3											
CO3	3	3											
CO4	3	2	2		2						1		
CO5	2	1			2						1		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	Components		Duration (min)	Marks Conducted for	Marks reduced to	40% Min Marks in each component to write SEE
1	Theory- Internal	IA-1	90	50	20	16

	Assessment	IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each)**,** with **2** questions from each of the 5 Modules**,** ensuring 100% syllabus coverage**.** Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks : 40% of Max Marks.

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Pattern Recognition				
Subject Code:	**22EC6OE52**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Understand** the fundamental concepts of pattern recognition systems.
2	**Learn** the concepts of Probability theory, random variables, joint distribution and density function.
3	**Study** the principles of statistical decision and non-parametric decision making.
4	**Acquire** the knowledge of various clustering methods.

Module	**Description**	**Hrs**
I	**Introduction to pattern recognition:** Introduction, machine perception-an example, pattern recognition systems, the design cycle, learning and adaptation, applications of pattern recognition, statistical decision theory, image processing and analysis. (Text 2: 1.1-1.5, Text 1: 1.1 – 1.3)	6
II	**Probability:** Introduction, Probabilities of events, random variables, joint distributions and densities, moments of random variables, estimation of parameters from samples, problems. (Text 1: 2.1 – 2.6)	8
III	**Statistical decision making:** Introduction, Bayes' theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, Leaving-One-Out Technique, problems. (Text 1: 3.1 -3.5, 3.8)	9
IV	**Nonparametric decision making:** Introduction, histograms, kernel and window estimators, adaptive decision boundaries, adaptive discriminant functions, problems. (Text 1: 4.1 – 4.4, 4.6)	9

V	**Clustering:** Introduction, hierarchical clustering, agglomerative clustering algorithm, single-linkage algorithm, complete-linkage algorithm, average- linkage algorithm, wards method, partitioned clustering: Forgy's algorithm, K-means algorithm problems. (Text 1: 5.1 – 5.3)	8

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Pattern Recognition and Image Analysis.	Earl Gose, Richard Johnsonbaugh, Steve Jost	Pearson, 978-93-325-4979-1, 2015
2	Pattern Classification.	Richard O. Duda, Peter E. Hart, David G. Stork	Wiley, 978-81265-1116-7, 2009

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Pattern Recognition.	Konstantinos Koutroumbas Sergios Theodoridis	Academic Press, 2008 ISBN: 978-1-597-49272-0
2	Pattern Recognition and Machine learning.	Christopher M Bishop	Springer, 2009 ISBN-13:978-0-387-31073-2
3	Pattern Recognition.	Narasimha Murthy	Universities Press, 2011 ISBN-13: **978-8173-717-253**

Course Outcomes:

Course outcome	Descriptions
CO1	**Explain** various techniques involved in pattern recognition.
CO2	**Apply** the knowledge of probability to statistical and non-

	parametric decision making.
CO3	**Analyze** classification problems and estimate classifier performance.
CO4	**Solve** the principles of clustering approaches to pattern recognition.
CO5	**Illustrate** decision-making algorithms in pattern recognition.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2		2	2	2									
CO3		2	2	1									
CO4		2	2	1									
CO5	2		1										

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal Assessment	IA-1	90	50	20	16
		IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.
Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based

Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.
Semester End Examination(SEE) : Max 100 Marks, Duration: 3 Hrs. The question paper shall contain 10 full questions (20 marks each), with **2** questions from each of the 5 Modules, ensuring 100% syllabus coverage. Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions. **Minimum passing Marks : 40% of Max Marks.**

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Robotics				
Subject Code:	**22EC6OE53**	**L – T – P – S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No.	**Course Objectives**
1	**Acquire** the knowledge of basic components of a robot anatomy.
2	**Learn** the various types of end effectors and sensors.
3	**Understand** programming concepts of robot kinematics.
4	**Study** the sensors and devices in robot application and vision system.

Module	**Description**	**Hrs**
I	**Fundamentals of robot**: Introduction, robot anatomy , co-ordinate systems, work envelope types and classification, specifications, pitch, yaw, roll, joint notations, speed of motion, pay load- robot parts and their functions-need for robots, different applications. (Text 1: 1.1 to 1.6, 2.1 to 2.5)	8
II	**Robot drive systems and end effectors:** Introduction, pneumatic drives, hydraulic drives, mechanical drives, electrical drives, d.c. servo motors, stepper motors, a.c. servo motors-salient features, applications and comparison of all these drives, end effectors-grippers-mechanical grippers, pneumatic and hydraulic- grippers, magnetic grippers, vacuum grippers; two fingered and three fingered grippers; internal grippers and external grippers; selection and design considerations. (Text 2: 5.1 to 5.4)	9
III	**Kinematics:** Introduction, direct kinematic model, mechanical structure and notations, description of joints and links. kinematic modeling of the manipulator, Denavit – Hartenberg notation. (Text1: 3.1 to 3.4)	9

IV	**Path planning:** Introduction, definitions of trajectory planning, Trajectory planning problem, terminology, steps in trajectory planning, classification of trajectory planning, types of trajectory function tasks, joint space techniques, Cartesian space technique. (Text 1: 7.1 to 7.3)	8
V	**Robotic sensors and vision:** Introduction, definitions, sensors and robotics, kinds of sensors used in robotics. robotic vision, industrial applications of vision –controlled robotic vision systems. (Text 1: 9.1 to 9.5)	8

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Robotics And Control	R K Mittal And I J Nagarth	McGraw – Hill, 2002
2	Industrial Robotics – Technology, Programming and Applications	M.P.Groover	McGraw – Hill, 2nd edition, 2000

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Robotics Control, Sensing, Vision and Intelligence	Fu.K.S, Gonzalz.R.C., and Lee C.S.G.,	McGraw-Hill Book Co., 2000 Reprint
2	Robotic engineering- An Integrated Approach	Richard D. Klafter, Thomas A. Chmielewski and Michael Negin	Prentice Hall India Learning Private Limited, 1997
3	Robotics and Image Processing	Janakiraman. P. A	McGraw Hill Education India Pvt Ltd, 2002

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the Robotic basics and their classification.
CO2	**Analyze** the drive system and end effector of robotics.
CO3	**Apply** kinematic models using Denavit–Hartenberg notation and implement them using simulation software.
CO4	**Interpret** the Kinematics and path planning for Robotic system.
CO5	**Design** robotic sensors for vision.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1					2								
CO2	3										2		
CO3	3				2			2	1	1	2		
CO4	1				3			2	2	2	2		
CO5	1		2		2						2		

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks						
Sl. No.	**Components**		**Duration (min)**	**Marks Conducted for**	**Marks reduced to**	**40% Min Marks in each component to write SEE**
1	Theory- Internal	IA-1	90	50	20	16

	Assessment	IA-2	90	50	20	
2	Activity Based Learning	ABL1	-	25	5	4
		ABL2	-	25	5	
Total CIE				150	50	20

IA-1 Syllabus: 2 ½ Module , IA-2 Syllabus: 2 ½ Module.

Activity Based Learning(ABL): Online course with certification, Hobby project, Simulations, Industrial Visits, Community-Based Learning, Case-study, Problem-Based Learning, Peer Teaching, web page design, student publications, Hackathons, Quiz (Leetcode, GitHub, Hackaranks and company specific quiz), Student Development program(1 week/online or offline), ……Etc.

Semester End Examination (SEE) : Max 100 Marks, Duration: 3 Hrs.

The question paper shall contain 10 full questions (20 marks each)**,** with **2** questions from each of the 5 Modules**,** ensuring 100% syllabus coverage**.** Students shall answer any 5 full questions with 1:1 choice. Each question may have a maximum of 4 sub-divisions.

Minimum passing Marks: 40% of Max Marks.

Department: Electronics and Communication Engineering		**Semester:**	**6**
Subject: Mini Project			
Subject Code:	**22ECMP607**	**L – T – P – C:**	**0 – 0 – 42 – 18**
		Credits	**2**

Description

Guidelines for Student Project Work:

- ✓ Students (Maximum-3, becomes one Group) shall carry out a detailed survey on the area and the topic on which they are interested to do the Mini project work.
- ✓ Each group instructed to prepare synopsis of three different topics with tittle of the Mini project work and submit to class teachers.
- ✓ Project Evaluation Committee (PEC) will review the synopsis and suggest suitable title in relevance to recent trends in Electronics and Communication Engineering domain and allot the guide.
- ✓ Each group instructed to give a detailed presentation and justify the tittle of the project with problem definition.
- ✓ Each group meet the guide frequently (every two weeks) with Project Dairy (100 Pages ruled note book) and discuss the work progress.
- ✓ Each guide has to write the observations and recommendations in the Project Diary, during every meeting. Get the signature of the Guide and HoD.
- ✓ Upon successful implementation of the project work, the group should prepare the project report according to the prescribed format. The report must be revised until it is fully approved by both the guide and the PEC member.
- ✓ After successful implementation of the Project work each group has to make an arrangement for final demonstration of the work in the department.
- ✓ Concerned Guide and PEC members evaluate the work as per Rubrics during the Project work Seminar, as per calendar of events.
- ✓ Final presentation involves: Introduction, Literature Survey (Minimum 06 papers), Problem Statement, Motivation, Objectives, Proposed methodology for solving societal problems.

CIE-Continuous Internal Evaluation: Continuous evaluation will be done by respective Project Guides and PEC members based on the Regularity, Technical Knowledge and Competence, Programming Skills, Communication Skills, Demonstration skills, Collaborative Learning and Documentation Skills of the students.

Course Outcomes:

Course outcome	Descriptions
CO1	**Identify** the electronic solutions for day to day societal problems with available tools.
CO2	**Develop** the system according to the problem stated in project work.
CO3	**Analyze** the performance of the system and prepare a project report.

Course Articulation Matrix:

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

Mini project

CIE evaluation (50 Marks)

Evaluation Parameters	Marks
Synopsis evaluation by DPEC (Novelty, societal , Industry based)	10
Meeting regularity and Presentation	15

Demonstration	15
Exhibition of the work in Hackathons/ Ideathons / Createthons	5
Report writing	5
Total	**50**

SEE Evaluation (50 Marks)

Mini project work will be evaluated at the end of 6th semester jointly by one internal and one external examiner appointed by the Chairman BoE

Evaluation Parameters	Marks
Write Up	08
Project Report, presentation, demonstration and quality of the project	35
Viva-Voce	07
Total	**50**

Department: Electronics and Communication Engineering			**Semester:**	**6**
Subject: Placement Training				
Subject Code:	**22SK608**	**L – T – P – S:**	**0-0-28-2 (In Hrs)**	
			Credits:	**1**

Sl. No.	**Course Objectives**
1	To **build** strong aptitude, logical reasoning, and problem-solving abilities essential for competitive assessments.
2	To **develop** professional grooming, workplace ethics, and effective interview skills for career readiness.
3	To **enhance** communication proficiency through structured email, virtual communication, and business etiquette.
4	To **impart** solid foundations in C and C++ programming, covering structured and object-oriented paradigms.
5	To **equip** students with data structure and algorithmic knowledge to solve real-world computational problems.

Module	**Description**	**Hrs**
I	**Reasoning Aptitude : Logical Aptitude –** Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. **Linear Seating Arrangement:** Single or Double rows facing each other or away from each other in the same direction **Circular Seating Arrangement**: Uni- & Bi-directional problems on Circular, Square, Rectangular, Hexagonal tables **Coding Decoding:** Letter Coding, Number Coding, symbol coding Crypt arithmetic: Basic concepts , addition , subtraction,	**3**

	multiplication of coded alphabets, Types of cryptarithm Clocks and Calender **Reasoning –** a. Verbal **–** Blood Relation, Sense of Direction, Arithmetic & Alphabet.Non- Verbal reasoning **–** Visual Sequence, Visual analogy and classification.Analytical Reasoning **–** Single & Multiple comparisons, Linear Sequencing. **Verbal Aptitude: Brush Up on** Reading Comprehension, Para Jumbles, Sentence Completion, Antonyms/Synonyms, Error in Sentences, Sentence Rearrangement, Idioms and Phrases, Verbal Analogies, Articles. **Quantitative Aptitude – I:** Permutation and Combination: Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle. Probability: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes. **QuantitativeAptitude – II:** Brush Up on: Number System, Percentage, Interest : Simple Interest, Compound Interest, Mixed Interest, Installments. **Data Interpretation:** Approach to interpretation **–** simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data**–** Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs. **QuantitativeAptitude – III:** Data Sufficiency: Questions based on Quantitative aptitude, Reasoning aptitude , Puzzles. **Quantitative Aptitude – IV:** Ratio and Proportion - Simple Ratios, Compound Ratios, Comprehend and Dividend, Direct &	

	Indirect Proportions, Problems on ages, Mixtures & Allegation Speed, Time and Distance, Relative Speed, Average Speed, Problems on Train, Boat & Stream, Time and Work, Work Efficiency, Work & Wages Pipes & Cisterns.	
II	**Grooming: Work Ethic and Professionalism:** Defining Work Ethic, Traits and Characteristics, The Importance of Reliability and Accountability, Maintaining Confidentiality, Building a Positive Professional, Image Balancing, Professionalism with Personal Authenticity. **Interview Skills:** Introduction to Interviews, The Purpose of an Interview, Different Types of Interviews: Telephonic, Face-to-face, Panel, Behavioral, and Technical. **Before the Interview:** Researching the Company/Organization, Analyzing the Job Description, Preparing Relevant Answers for Common Interview Questions. **During the Interview:** Dress Code and Personal Grooming, Body Language: Eye Contact, Posture, and Handshake, Listening Actively and Responding Clearly, Asking Thoughtful Questions to the Interviewer. **Technical vs Behavioral Interviews:** Understanding Technical Skill Evaluation, STAR Technique (Situation, Task, Action, Result) for Behavioral Questions. **Handling Challenging Questions and Situations:** Addressing Gaps in Employment, Discussing Strengths, Weaknesses, and Failures, Navigating Salary Discussions. **After the Interview:** Crafting a Follow-up Email or Letter, Reflecting on Interview Performance, Preparing for the Next Steps.	**3**

III	**Email and Virtual Communication:** Email Etiquette: Do's and Don'ts, Crafting Effective Emails, Clarity, Brevity, and Tone, Best Practices for Virtual Meetings (Zoom, Teams, etc.), Virtual Communication Tools, Navigating Time Zones, Cultural Differences, and Other Challenges **Business Etiquettes:** Greetings and Introductions in Business Settings, Business Dining Etiquette, Dress Code and Personal Grooming, Electronic Etiquette: Phone, Email, and Social Media, International Business Etiquette: Understanding Cultural Differences. **Technical skills:** Competitive Coding with C Programming: Covered Topics. **C Programming (A):** Data Types, Operators, and Expressions, Input and Output Operations, Control Flow: Branching and Looping- Statements and Blocks, If..Else, Switch, Nesting of If..Else, GOTO Statement, The While Statement, The For Statement, The Do Statement, Jumps in Loops **C Programming (B):** Arrays and Strings, One-dimensional	**3**
IV	**C++: Object oriented Programming:** Class and Objects, Dynamic Memory Management POP, OOPs in C++, Console Input / Output in C++, Comment lines in C++, Importance of function prototyping in C++, Function overloading, Inline functions and default arguments, Scope Resolution Operator, Structures, Defining function outside the class, Friend functions, Friend class, Array of class objects, Passing class objects to and returning class objects from functions, Nested classes, Namespaces, Dynamic memory allocation using new and de-allocation, new handler function.	**3**
V	**Data Structures:** Introduction to Data-structures, Arrays and Strings, Recursion Data Structures, Types, Arrays, Structures, Self-Referential Structures, and Unions, Pointers and Dynamic Memory Allocation, Operations related data-structures Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays, Sorting and searching in arrays,	**2**

	Operations on arrays: inserting, deleting traversing, Stacks, Queues, Linked lists, Stack operations, implementing queue using stack, Applications of stack: converting Infix to postfix expressions, Evaluating expressions, Using stacks to represent arrays, Types of queues: Ordinary queue, Circular queue, Priority queue, Dequeue, Implementing queue using multiple stacks, Drawback in stacks and arrays, Advantages of linked list over stacks and queues with memory examples,• Types of linked list, Writing examples on singly linked list, Doubly linked lists and circular linked lists, Various operations like insertion deletion and searching for a element in linked list and reversing linked list,• Implementing arrays queues and stacks using linked list. **Trees, Graphs and Traversal Methods, Sorting and Searching, Hashing:** Creating trees using linked list data-structures, Binary tree programming examples, Types of binary trees, Solving problems on Inorder Preorder and Postorder traversal of Binary trees, Binary tree operations, Writing threaded binary trees, Insertion deletion and traversal of Binary search trees, Applications of trees, valuation of expressions using trees, Programming examples, Different types of representing graphs: Adjacency list and matrix representation, Various graph operations and terminologies **Hashtag**: Hashtag Programming, Hash-table organization, Hashing functions, Static and Dynamic hashing. **Algorithms**: Sorting Algorithm-1.Bubble sort, 2.Selection sort, 3.Insertion sort, 4.Merge sort, 5.Quick sort, 6.Shell sort, 7.Heap sort **Searching Algorithm:** 1.Linear search, 2.Binary search, Greedy Algorithm, Divide & conquer Algorithm, Dynamic Programming.	

Text Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	Let Us C by Yashavant Kanetkar	Yashavant Kanetkar	ISBN-10: 8183331637
2	How to Prepare for Quantitative Aptitude for	Arun Sharma	10th Edition, 2021 , ISBN-10: 9354641479
3	Let Us C++ by Yashavant Kanetkar	Yashavant Kanetkar	ISBN-10: 818333167X

Reference Books:

Sl. No.	Text Book title	Author	Volume and Year of Edition
1	The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie	Dennis M. Ritchie	ISBN-10: 0131103628
2	C++ Primer by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo	Stanley B. Lippman	ISBN-10: 0321714113

Course outcome:

Course outcome	Description
CO1	**Solve** reasoning and quantitative aptitude problems using analytical techniques and shortcuts.
CO2	**Demonstrate** professionalism and employability skills through effective grooming and interview preparedness**.**
CO3	**Communicate** effectively in academic and corporate settings using appropriate email, virtual, and business etiquette.
CO4	**Apply** programming concepts in C and C++ to design and

	implement modular and object-oriented solutions.
CO5	**Design, analyze,** and implement data structures and algorithms to **solve** complex computational problems.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2							
CO2		2					3	3	2	2	2		
CO3		2					3	3	2	2	2		
CO4	3	2	3	2	2	2					2		
CO5	3	3	3	3	3	2					3		

Course Assessment and Evaluation:

Sl. No.	Components		Duration (min)	Marks Conducted for	Min Marks To pass the Course
1	Theory- Internal Assessment	IA-1	90	50	40
		IA-2	90	50	
	Total CIE			100	40