SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU-572105

(A constituent College of Siddhartha Academy of Higher Education, Deemed-to-be-University)

Scheme of Teaching and Examination (88 Credits, 2024-SCHEME)

FIRST YEAR MTECH (DIGITAL ELECTRONICS), ACADEMIC YEAR 2024-25

1st SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24DEL11	**Digital Circuits and Logic Design**	ECE	4	-	-	**4**	50	50	100	3
2	PC	24DEL12	**VLSI Design**	ECE	4	-	-	**4**	50	50	100	3
3	PC	24DEL13	**Advanced Embedded System Design**	ECE	4	-	-	**4**	50	50	100	3
4	PC	24DEL14	**Research Methodology & IPR**	ECE	3	-	-	**3**	50	50	100	3
5	PE	24DEL15x	**Professional Elective-I**	ECE	3	-	-	**3**	50	50	100	3
6	PE	24DEL16x	**Professional Elective-II**	ECE	3	-	-	**3**	50	50	100	3
7	PC	24DELTS1	**Technical Seminar-I**	ECE	-		3	**1.5**	50	-	50	-
8	PC	24DELLB1	**Embedded System Lab**	ECE	-	-	3	**1.5**	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	21	-	6	**24**	**400**	**300**	**700**	-

Professional Elective-I		**Professional Elective-II**	
Course Code	**Course Title**	**Course Code**	**Course Title**
24DEL151	Advanced Digital Signal processing	24DEL161	Synthesis and Optimization of Digital Circuits
24DEL152	Reliability Engineering	24DEL162	Optical Communication and Networking
24DEL153	Nano Electronics	24DEL163	Adhoc and Wireless Sensor Networks
24DEL154	Advanced Communication System	24DEL164	Data Compression

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Scheme of Teaching and Examination (88 Credits, 2024-SCHEME)

FIRST YEAR MTECH (DIGITAL ELECTRONICS), ACADEMIC YEAR 2024-25

2nd SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24DEL21	**Advances in Image Processing**	ECE	4	-	-	**4**	50	50	100	3
2	PC	24DEL22	**Advanced Computer Architecture**	ECE	4	-	-	**4**	50	50	100	3
3	PC	24DEL23	**Real Time Embedded System**	ECE	4	-	-	4	50	50	100	3
4	PC	24DEL24	**Error Control Coding**	ECE	3	-	-	3	50	50	100	3
5	PE	24DEL25x	**Professional Elective-III**	ECE	3	-	-	**3**	50	50	100	3
6	PE	24DEL26x	**Professional Elective-IV**	ECE	3	-	-	**3**	50	50	100	3
7	PC	24DELTS2	**Technical Seminar-II**	ECE	-	-	3	**1.5**	50	-	50	-
8	PC	24DELLB2	**Image Processing Lab**	ECE	-	-	3	**1.5**	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	21	-	6	24	**400**	**300**	700	-

Professional Elective-III		**Professional Elective-IV**	
Course Code	**Course Title**	**Course Code**	**Course Title**
24DEL251	Digital System Design using Verilog	24DEL261	Simulation Modeling and Analysis
24DEL252	Automative Electronics	24DEL262	MEMS
24DEL253	Intelligent IOT System Design and Architecture	24DEL263	Pattern Recognition and Machine Learning
24DEL254	System on Chip Design	24DEL264	Wavelet Transform and Applications

SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU-572105
(A constituent College of Siddhartha Academy of Higher Education, Deemed-to-be-University)
Scheme of Teaching and Examination (88 Credits, 2024-SCHEME)
SECOND YEAR MTECH (DIGITAL ELECTRONICS), ACADEMIC YEAR 2024-25

3rd SEMESTER M.Tech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24DELIS1	**Internship**	ECE	-	-	-	**9**	100	-	100	-
2	PC	24DENE1	**Online Course: NPTEL/MOOC/SWAYAM**					**3**	50	50	100	
3	PC	24DELPW1	**Project Phase-I**	ECE	-	-	-	**08**	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	-	-	-	**20**	**150**	-	**150**	-

4th SEMESTER M.Tech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24DELPW 2	**Professional Work Phase- II**	**ECE**	-	-	-	**20**	100	200	300	-
2 Paper Publications is compulsory (Conference/Journal)												
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	-	-	-	20	**100**	**200**	300	-

Credits Distribution: 1st Sem=24, 2nd Sem =24, 3rd Sem=20, 4th Sem=20,
Total Credits=24+24+20+20=88 Credits

Department: Electronics and Communication Engineering			Semester:	1
Subject: Digital Circuits and Logic Design				
Subject Code:	**24DEL11**	**L – T – P - C:**		**4 – 0 – 0 – 4**

Sl. No	Course Objectives
1	To teach the students the possible methods of machine decomposition to reduce the dependencies on the variables
2	To explore the students on methods to identify faults in the digital circuits and their remedies
3	To design sequential circuits with minimal dependencies and computational costs
4	To allow the students to exercise to solve the problem of data deptencies on the outputs using different techniques

Unit	Description	Hours
I	**Functional Decomposition And Symmetric Functions**: Introduction, Functional Decomposition, Decomposition by expansion, Test for decomposability, Decomposition charts, Symmetric networks, Properties of symmetric functions, synthesis, complemented variables of symmetry, Identification of symmetric functions.	10
II	**Reliable Design and Fault Diagnosis Hazards**: Introduction, Fault detection by path sensitizing, Detection of multiple faults, Failure-Tolerant Design, Quadded Logic, Fault Detection in Combinational Circuits.	10
III	**Synchronous Sequential Circuits**: Fault-location experiments, Boolean Differences, Limitations of Finite – State Machines, State Equivalence and Machine Minimization, Simplification of Incompletely Specified Machines	10
IV	**Structure of Sequential Machines**: Introductory Example, State Assignments Using Partitions, The Lattice of closed Partitions, Reductions of the Output Dependency, Input Independence and Autonomous Clocks, Covers and Generation of closed Partitions by state splitting, Information Flow in Sequential Machines, decompositions, Synthesis of Multiple Machines	11
V	**State Identifications and Fault-Detection Experiments**: Introduction ,Homing Experiments, Distinguishing Experiments, Machine Identification, Fault Detection Experiments, Design of Diagnosable Machines, Algorithms for the Design of Fault Detection Experiments	11

Course Outcomes:

Course outcome	Descriptions
CO1	Apply the concepts of decomposition to simplify the structure of the digital systems
CO2	Analyse faults in the digital circuits using fault detection experiments on sequential circuits.
CO3	Design optimal sequential circuits which reduces the operations costs
CO4	Solve the problem of variable dependencies on the output using state machines

Course Articulation Matrix

CO \ PO/PSO	PO1	PO2	PO3
CO1	2		
CO2			3
CO3	2		
CO4			2

Text Books:

Sl. No	Title	Authors	Volume and Year of Edition
1	Switching and Finite Automata Theory	ZviKohavi	2nd Edition. Tata McGraw Hill Edition, ISBN-10: 0-07-099387-4
2	Fundamentals of Logic Systems	Charles Roth Jr	Cengage learning, 7th edition, 2013, ISBN-13: 978-1133628477

Reference Books:

Sl. No	Title	Authors	Volume and Year of Edition
1	Fault Tolerant and fault testable hardware design	Parag K Lala	Prentice Hall Inc. 1985
2	Introductory theory of computer	V. Krishnamurthy	Macmillan Press Ltd, 1983

Department: Electronics and Communication Engineering			Semester:	1
Subject: VLSI Design				
Subject Code:	24DEL12	L – T – P - C:		4 – 0 – 0–4

Sl. No	Course Objectives
1	To make the students learn the principles, operations and applications of MOSFET's.
2	To introduce the students to modelling and design of digital VLSI circuits using different CMOS design styles and CMOS sub system.
3	To make the students learn stick diagrams and layouts using Lambda based design rules for a given schematic and to categorize the different MOS Technologies

Unit	Description	Hours
I	**MOS Transistor Theory:** n MOS / p MOS transistor, threshold voltage equation, body effect, MOS device design equation, sub threshold region, Channel length modulation. mobility variation, Tunneling, punch through, hot electron effect MOS models, small signal AC Characteristics, CMOS inverter, βn/βp ratio, noise margin, static load MOS inverters, differential inverter, transmission gate, tri state inverter, Bi CMOS inverter. (Text1)	12
II	**CMOS Process Technology Silicon Semiconductor technology:** An overview, basic CMOS technology. A basic n-well CMOS process, The p-well process, twin tub process, silicon on insulator. (Text1) **CMOS process enhancements:** Interconnect, circuit elements; Resistors, Capacitors, bipolar transistors, thin film transistors,3DCMOS (Text1) **MOS Design Processes:** MOS layers, stick diagrams, design rules and layout, symbolic diagrams. (Text3)	10
III	**Basic circuit concepts:** Sheet resistance, standard unit of capacitance concepts, delay unit time inverter delays, driving capacitive loads, propagation delays, scaling of MOS circuits (Text3) **Basics of Digital CMOS Design:** Combinational MOS Logic circuits- Introduction, MOS logic circuits with depletion NMOS load. (Text2)	10
IV	**Basics of Digital CMOS Design: Contd.** CMOS logic circuits, complex logic circuits, CMOS Transmission Gate. (Text2) **Sequential MOS logic Circuits:** Introduction, Behavior of bi stable elements, SR latch Circuit, (Text2).	10
V	**Sequential MOS logic Circuits: Contd.** Clocked latch and Flip Flop Circuits, CMOS D- latch and triggered Flip Flop (Text2). **Dynamic CMOS and clocking:** Introduction, advantages of CMOS over NMOS, CMOS\SOS technology' CMOS\bulk technology, latch up in bulk CMOS, static CMOS design, Domino CMOS structure and design, Charge sharing, Clocking- clock generation, clock distribution, clocked storage elements. (Text4)	10

Course Outcomes:

Course outcome	Descriptions
CO1	Identify the different design techniques used in modeling the digital VLSI Circuits. (L1)
CO2	Estimate the parasitic values for different mask layers. (L2)
CO3	Outline the MOS process technology and CMOS sub system design. (L4)
CO4	Analyze the design parameters for the CMOS circuits. (L4)

Course Articulation Matrix

CO \ PO	PO1	PO2	PO3
CO1	2		
CO2		2	
CO3		1	2
CO4	2		2

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Principles of CMOS VLSI Design: A System Perspective	Neil Weste and K. Eshragian,	2nd edition, Pearson Education (Asia) Pte. Ltd., 2000.
2	CMOS Digital Integrated Circuits: Analysis and Design	Sung Mo Kang &YosufLederabic Law,	3rd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
3	Basic VLSI Design	Douglas A. Pucknell& Kamran Eshraghian	PHI 3rd Edition (original edition 1994), 2005.
4	Introduction to VLSI Design	Eugene D Fabricius	Mc Graw Hill, International Edition(Original Edition 1990).

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	CMOS VLSI Design: A Circuits and System perspective	Neil H. E. Weste, David Harris and Ayan Banerjee	Pearson Education Pvt. Ltd.,3rd Edition,2006
2	Introduction to VLSI circuits and systems	John P Uyemura	Wiley Indian Edition,2002
3	Modern VLSI design: System on Silicon	Wayne, Wolf	Pearson Education, Second Edition.2004

Department: Electronics and Communication Engineering			Semester:	1
Subject: Advanced Embedded System Design				
Subject Code:	24DEL13		L – T – P - C:	4 – 0 – 0 – 4

Sl. No	Course Objectives
1	To make students familiar with the basic concepts of embedded systems, applications in which they are used and various aspects of embedded system design from Hardware and Software point of view.
2	To equip students with knowledge and experience of Architecture & Programming concepts of ARM microcontrollers and their supportive devices.
3	To impart an in-depth understanding of different tools and methodologies needed for the development of smart, effective and low-cost embedded system applications.
4	To make students familiar with the basic concepts of embedded systems, applications in which they are used and various aspects of embedded system design from Hardware and Software point of view.

Unit	Description	Hours
I	**INTRODUCTION TO EMBEDDED SYSTEMS:** Evolution of microprocessors and embedded systems. General purpose computers vs Embedded systems. Performance and power consumption, Moore's law, Amdahl's law. ARM. Classifications: RISC, CISC, Flynn's Classification, Big- and little-endian CPI. Computer Architecture: Pipelining stages, Superscalar processing, Throughput and latency. **INTRODUCTION TO EMBEDDED SYSTEMS HARDWARE AND SOFTWARE:** Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency - Embedded system evolution trends – Interrupt routines in an RTOS environment.	**10**
II	**EMBEDDED NETWORKING:** Embedded Networking: Introduction, I/O Device Ports and Buses- Serial Bus communication protocols -RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) -need for device drivers. **ARM ARCHITECTURE: Cortex-M3/M4 Microcontroller TM32L15xxx ARM Cortex M3/M4 Microcontroller:**Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART.	**10**
III	**OVERVIEW OF CORTEX-M3 CORTEX-M3 BASICS:** Registers, general purpose registers, stack pointer, link register, program counter, special registers, operation mode, exceptions and interrupts, vector tables, stack memory operations, reset sequence. **Instruction Sets:** Assembly Basics, Instruction List, Instruction Descriptions. **Cortex-M3 Implementation Overview:** Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.	**10**
IV	**CORTEX-M3/M4 PROGRAMMING:** Typical Development Flow, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. **Exception Programming:** Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. **Memory Protection Unit and other Cortex-M3 features:** MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.	**10**
V	**Case Study and Embedded System Application Development:** Embedded system applications in home, infrastructures, buildings, security, Industries, Home appliances etc. Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (ARM Cortex)**.**	**12**

Course Outcomes:

CO1	To understand and explore various Embedded Development Strategies, Tools and Techniques available for design and development of embedded system applications.
CO2	Understand, Define, Explain and Explore Architecture & Programming of ARM microcontrollers.
CO3	Incorporate suitable microcontroller along with appropriate interfacing circuits and implement the same for an application with software programs.
CO4	Design systems based on ARM microcontroller and its interfaces.

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2		2
CO3	2		3
CO4		2	3

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Embedded System-Architecture, Programming, Design	Rajkamal,	Mc Graw Hill, 2013.
2	Embedded system Design	Peckol,	,John Wiley and Sons,2010

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Embedded Systems-An Integrated Approach,	Lyla B Das,	Pearson, 2013
2	"ARM System-on-Chip Architecture"	Steve Furber,	2nd Edition, Pearson Education
3	STM32L152xx ARM Cortex M3 Microcontroller Reference Manual	-	.

Department: Electronics and Communication Engineering		Semester:	1
Subject: Research Methodology and IPR			
Subject Code:	**24DEL14**	**L – T – P - C:**	**3 – 0 – 0–3**

Sl. No	Course Objectives
1	An overview of the research methodology, objectives of research, technique of defining a research problem and Literature survey.
2	Discuss the various research designs and their characteristics, Sampling designs and also different methods of data collections.
3	To explain the art of interpretation and the art of writing research reports.
4	To explain various forms of the intellectual property rights.

UNIT	Description	Hours
I	**Research Methodology:** Meaning, Objectives and Characteristics of research - Research Methods Vs Methodology -Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research -Developing a research plan and Problems Encountered by Researchers in India.	8
II	**Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem. - Importance of literature review in defining a problem - **S**urvey of literature. **Research design and methods** – Research design, Basic Principles, Need of research design, Features of good design, Important concepts relating to research design.	8
III	**Sampling design** - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques. **Methods of data collection** – Collection of primary data - Data collection instruments.	7
IV	**Interpretation and report writing** - Techniques of interpretation - Structure and components of scientific reports - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis.	8
V	**IPRs**- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs- Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures.	8

Course Outcomes

Course Outcome	Descriptions
CO1	Understand research problem formulation.(L2)
CO2	Analyze how to collect the data related to the research.(L4)
CO3	Present research output in a structured report as per the technical and ethical standards.
CO4	Understand that IPR protection provides an incentive to inventors for further research.(L2)

Course Articulation Matrix

CO \ PO	PO1	PO2	PO3
CO1	3		2
CO2		2	
CO3	2	3	
CO4	3		2

Text Books:

SL. No	Text Book title	Author	Volume and Year of Edition
1	Research Methodology: Methods and Techniques	C.R. Kothari, Gaurav Garg	4th Edition, 2018
2	Handbook on Intellectual Property Law and Practice	Subbarau NR	S Viswanathan Printers and Publishing Private Limited.1998

Reference Books:

SL. No	Text Book title	Author	Volume and Year of Edition
1	Research Methodology: Methods and Techniques	Ranjit Kumar	SAGE PublicationsLtd 3rd Edition, 2011
2	Research Methodology	Sinha, S.C. and Dhiman, A.K.,	EssEss Publications. Volumes-2.
3	Professional Programme Intellectual Property Rights, Law and Practice	The Institute of Company Secretaries of India	Statutory Body Under an Act of Parliament, September 2013
4	Intellectual Property Rights in the Global Economy	Keith Eugene Maskus	Institute for International Economics, Washington, DC, 2000

Department: Electronics and Communication Engineering		Semester:	1
Subject: Advanced Digital Signal Processing			
Subject Code:	**24DEL151**	**L – T – P - C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	To teach the students the concepts of signal's linearity, time invariance and the representation in z-domain
2	To explore the students on design concepts and their implementation of various filters
3	To practice the construction of multirate systems to optimize the computational costs
4	To teach the concepts of linear predication and optimum linear filters

Unit	Description	Hours
I	**Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems**: Introduction, Discrete time systems, analysis of discrete time linear invariant systems, implementation of discrete time systems, correlation of discrete time systems, z-transforms, linear time invariant systems as frequency selective filters. Sampling	7
II	**The Discrete Fourier transforms, properties and applications**: Introduction, Frequency domain sampling, properties of DFT, linear filtering methods based on DFT, Frequency analysis of signals using the DFT, Radix-2 decimation in time domain and decimation in frequency domain algorithms	8
III	**Design of Digital filters**: Introduction, Design of FIR filters, Design of IIR filters, frequency transformations	8
IV	**Multirate digital signal processing**: Decimation, Interpolation, Sampling rate conversion, filter design and implementation for multirate conversion, Sampling rate conversion by an arbitrary factor, applications of multirate signal processing.	8
V	**Linear prediction and optimum linear filters**: Introduction, Forward and backward linear prediction, solution of the normal equations, wiener filters, Power spectrum estimation, Non-parametric and parametric methods for power spectrum estimation.	8

Course Outcomes

Course outcome	Descriptions
CO1	Analyse the concepts of linearity, time invariance and z-domain signals
CO2	Design and implement different finite and infinite impulse response filters
CO3	Construct multirate structures for the digital signal processing systems to reduce the computational costs
CO4	Interpret the concepts of linear prediction and optimum linear filters

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	2		
CO2			3
CO3			2
CO4	2		

Text Books:

Sl. No	Title	Authors	Volume and Year of Edition
1	Digital Signal Processing	Proakis and Manolakis	Prentice Hall 1996 (third edition)
2	Modern Digital Signal Processing	Roberto Cristi	Cengage Learning; 1ST edition , 2003, ISBN-13: 978-0534400958

Reference Books:

Sl. No	Title	Authors	Volume and Year of Edition
1	Digital Signal Processing, a practitioners approach	E.C. Ifeachor and B W Jarvis	II Edition, Pearson Education, India, 2002 Reprint.
2	Theory and Application of Digital Signal Processing	Lawrence R.Rabiner and Bernard Gold	Prentice Hall (1975)

Department: Electronics and Communication Engineering			Semester:	1
Subject: Reliability Engineering				
Subject Code:	**24DEL152**		**L – T – P - C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Understand and emphasizes dependability in the lifecycle management of a product.
2	Apply and identify and manage assets reliability risks that could adversely affect plant or business operations.
3	Understand the concepts related to reliability engineering
4	Apply the concepts of reliability management

Unit	Description	Hours
I	**Introduction**: Basic definitions: Reliability, Availability, Serviceability, Failure rate, Reliability Mathematics, Failure distribution - constant failure rate model, Time dependent failure rate models and its types	8
II	**System Reliability:** Reliability Block Diagram - Series, Parallel & combined series parallel configurations; redundant-active and passive types, Failure Mode, Effects and Criticality Analysis (FMECA), Fault Tree Analysis (FTA)	**8**
III	**Reliability testing:** Failures and types of failures; Intrinsic & extrinsic failures; Failure cascade; Failure mode; Failure rate, MTTF, MTBF, Accelerated life testing (ALT) -Qualitative ALT, Quantitative ALT	8
IV	**Reliability estimation and life Prediction:** Types of Failure data - Data censoring, Parametric and Non-Parametric distribution, Probability density function, Exponential, Normal, lognormal & weibull distributions, weibull Goodness of fit distributions	8
V	**Reliability Management:** Introduction to Reliability Engineering Management, Reliability Value, Maturity Matrix, Goals and Planning, Basic models, environment and use of, Failure Sources, Identifying risk, Best reliability data, Basic reliability testing, Robust by design, Supply chain reliability, Building Culture.	7

Course Outcomes:

Course outcome	Descriptions
CO1	Interpret the basic concepts of reliability engineering and its measures. (L2)
CO2	Predict the reliability at system level using various models. (L3)
CO3	Design the test plan to meet the reliability requirements(L3)
CO4	Predict and estimate the reliability from failure data(L1)

Course Articulation Matrix

CO \ PO/PSO	PO1	PO2	PO3
CO1	3		3
CO2	2		2
CO3	2		2
CO4	3		3

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Reliability Engineering	Kailash C. Kapur, Michael Pecht,	**John Wiley** & **Sons, 2014**
2	Reliability Engineering	Srinath L.S	**East-West Press Pvt. Ltd**, **New Delhi**,**1998**

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Reliability and Risk analysis	Modarres	Marshal Dekker Inc.1993
2	Introduction to Reliability in Design	Smith C.O. Roy Billington and Ronald N. Allan	McGraw Hill, London, 1976
3	An introduction to Reliability and Maintainability engineering	Charles E. Ebeling,	TMH, 2004

Department: Electronics and Communication Engineering			Semester:	1
Subject: Nano Electronics				
Subject Code:	**24DEL153**		**L – T – P - C:**	**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	To Introduce the fundamental principles and theories underlying nanoelectronics and nanoscale devices.
2	To understand the fabrication techniques and material properties essential for nanoelectronics.
3	To learn about various nanoelectronic devices, their design, and their applications and to explore the current trends and future directions in nanoelectronics.

Unit	Description	Hours
I	**Introduction to Nanoelectronics** Foundational aspects of nanoelectronics, Classification of nanostructures and examines the electronic properties of atoms and solids, Effects of the nanometer length scale and introduces both top-down and bottom-up fabrication methods (Text Book 1: Chapter 1,2,3)	07
II	**Characterization Techniques** Techniques used to characterize nanomaterials and nanostructures, Diffraction techniques for bulk and surface analysis, Spectroscopy techniques that use photons, radiofrequency, and electrons, Reflectometry and methods for measuring the mechanical, electronic, magnetic, and thermal properties of nanomaterials. (Textbook 1: Chapter 4,5).	08
III	**Nanostructures and Carbon Nanotechnology** Inorganic semiconductor nanostructures and the physics underlying them. Quantum confinement in structures like quantum wells, wires, and dots, along with super-lattices, band offsets, and electronic density of states. Carbon nanostructures, including carbon molecules, clusters, and nanotubes, and examines their applications in various fields. (Textbook 1: Chapter 6, Text Book 2: Chapter 3).	08
IV	**Fabrication Techniques and Physical Processes** Techniques used for fabricating semiconductor nanostructures. Strain-induced and electrostatically induced dots and wires, quantum well fluctuations, and thermally annealed quantum wells. Semiconductor nanocrystals, colloidal quantum dots, and self-assembly techniques. The physical processes in these structures, such as modulation doping, quantum Hall effect, resonant tunneling, ballistic carrier transport, light emission processes, and the characterization of these nanostructures. (Text Book 1: Chapter 7,8,9).	08
V	**Applications and Advanced Topics** Advanced measurement methods and applications of nanoelectronics. Applications discussed include injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, Coulomb blockade devices, photonic structures, quantum well infrared photo detectors (QWIPs), nanoelectromechanical systems (NEMS), and microelectromechanical systems (MEMS). (Text Book 1: Chapter 10, Text Book 2: Chapter 4).	08

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the basic principles and theories underlying nanoelectronics and nanoscale devices (L1).
CO2	Comprehend and explain the fabrication techniques and material properties essential for nanoelectronics (L2).
CO3	Articulate the design and working principles of various nanoelectronic devices and their applications (L3).
CO4	Evaluate the current trends and potential future directions in the field of nanoelectronics (L4).

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3
CO1	3	1	3
CO2	2	2	2
CO3	2	3	3
CO4	3	2	3

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Nanoelectronics and Information Technology	Rainer Waser	Wiley-VCH, 3rd Edition, 2012
2	Introduction to Nanoscale Science and Technology	Massimiliano Di Ventra, Stephane Evoy, James R. Heflin	Springer © 2004
3	Handbook of Nanophysics: Nanoelectronics and Nanophotonics	Klaus D. Sattler	CRC Press, 2010

Department: Electronics and Communication Engineering			Semester:	1
Subject: Advanced Communication System				
Subject Code:	**24DEL154**	**L – T – P - C:**		**3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Understand the coherent and non-coherent receivers and their performance under AWGN channel conditions
2	Learn the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI
3	Differentiate channel models, channel capacity and different block coding techniques
4	Know the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

Unit	Description	Hours
I	**COHERENT AND NON-COHERENT COMMUNICATION** Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; MDPSK-BER Performance Analysis. Carrier Synchronization Bit synchronization., Text1: 1.1-1.6	8
II	**EQUALIZATION TECHNIQUES** Band Limited Channels-ISI– Nyquist Criterion- Controlled ISI-Partial Response signals Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms. Text1:9.6-9.8	8
III	**MIMO COMMUNICATIONS** Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding: STBC, STTC, Spatial Multiplexing and BLAST Architectures. Text2 chapter 8	8
IV	**RECEIVER DIVERSITY** Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter. Text 2-chapter 5	8
V	**MULTICARRIER AND MULTIUSER COMMUNICATIONS** Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation. Text1: chapter 11	7

Course Outcomes:

Course Outcome	Descriptions
CO1	Differentiate coherent and non-coherent receivers and analyse their performance under AWGN channel conditions
CO2	Identify the concepts in MIMO Communications and equalization techniques.
CO3	Interpret the concepts of multi carrier and multi user communication
CO4	Apply implication of diversity combining methods and the knowledge of channel

Course Articulation Matrix

CO \ PO	PO1	PO2	PO3
CO1	3		2
CO2		2	
CO3	2	3	
CO4			

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Digital Communication	John G. Proakis and Masoud Salehi	Fifth Edition, Mc Graw Hill Publication, 2014
2	Fundamentals of wireless communications	David Tse and Pramod Viswanath	Cambridge University Press, First Edition, 2012

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Digital communication Systems	Simon Haykin	John Wiley and sons, 2014
2	Digital Communications Fundamentals & Applications	Bernard Sklar and Pabitra Kumar Ray	second edition, Pearson Education, 2009
3	Principles of Mobile Communication	Gordon L. Stuber	Springer International Ltd., 2001

Department: Electronics and Communication Engineering			Semester:	1
Subject: Synthesis And Optimization Of Digital Circuilts				
Subject Code:	24DEL161		L – T – P - C:	3 – 0 – 0 -- 3

Sl. No	Course Objectives
1	Understand different methods used for the simplification of Boolean functions.
2	Define the formal procedures for the analysis and synthesis of combinational circuits and sequential circuits using computer aided synthesis.
3	Learn the concepts of system modelling and different optimizations of combinational, synchronous, and asynchronous sequential circuits.

Unit	Description	Hours
I	**Introduction:** Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization. **Graphs:** Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.	08
II	**Hardware Modeling:** Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, dataflow and sequencing graphs, compilation and optimization techniques.	08
III	**Two Level Combinational Logic Optimization:** Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.	08
IV	**Multiple Level Combinational Optimizations:** Models and transformations for combinational networks, algebraic model, Synthesis of testable network, algorithm for delay evaluation and optimization, rule based system for logic optimization.	08
V	**Sequential Circuit Optimization:** Sequential circuit optimization using state based models, sequential circuit optimization using network models. **Cell Library Binding:** Algorithms for Technology mapping – Structural andBoolean matching, Simulation & Static Timing analysis - Event driven simulation – zero delay, unit delay and nominal delay simulation, Timing analysis at the logic level, Delay models, Delay graph, static sensitization.	07

Course Outcomes:

Course outcome	Descriptions
CO1	Explain the terminologies of graph theory and its algorithms to optimize a Boolean equation. (L2)
CO2	Outline the process of synthesis and optimization in a top-down approach for digital circuits models using HDLs. (L2)
CO3	Apply different two level and multilevel optimization algorithms for combinational circuits. (L3)
CO4	Build different sequential circuit optimization methods using state models and network models(L3).

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	3		3
CO2	2		2
CO3	3		3
CO4	3		3

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1.	Synthesis and Optimization of Digital Circuits	Giovanni De Micheli	Tata McGraw-Hill, 2003.
2.	Logic Synthesis	Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer	McGraw-Hill, USA, 1998.

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Logic Synthesis and Verification Algorithms	G. D. Hachtel and F. Somenzi	Kluwer Academic Publishers, 1996.
2	Logic Synthesis and Verification	S. Hassoun and T. Sasao, (Editors)	Kluwer Academic publishers, 2002

Department: Electronics and Communication Engineering			Semester:	1
Subject: Optical Communication and Networking				
Subject Code:	24DEL162		L – T – P - C:	3 – 0 – 0 - 3

Sl. No	Course Objectives
1	Understand and emphasizes the need of optical communication.
2	Apply and identify the concept s of communication with the need of band width.
3	Understand the concepts related to the field of fiber optics.
4	Apply the concepts of reliability of OFC in the field of digital communication.

Unit	Description	Hours
I	**Overview of optical fiber communication:** Introduction, historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations in article 2.4.4), single mode fiber, cutoff wave length, mode filed diameter. Optical Fibers: fiber materials, photonic crystal, fiber optic cables specialty fibers.	8
II	**Transmission characteristics of optical fibers:** Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion.	**8**
III	**Optical sources and detectors:** Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors.	8
IV	**fiber Couplers and connectors:** Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers.	8
V	**Optical receiver:** Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst mode receiver, operation, Analog receivers.	7

Course Outcomes

Course outcome	Descriptions
CO1	Interpret the basic concepts of fiber optics and its construction (L2)
CO2	Predict the different losses for different fiber materials. (L3)
CO3	Design and analyze the band width requirements in OFC (L3)
CO4	Predict and estimate the reliability of the fibers used in communication(L1)

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	3		3
CO2	2	1	2
CO3	2		2
CO4	3	2	3

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	**Optical fiber communication.**	keiser-gerd.E	McGraw-Hill Higher Education, 1983 ISBN 10: 0070334676ISBN 13: 9780070334670
2	**Optical Fiber Communications: Principles and Applications**	T.L.Singal.	Cambridge University Press Format: Paperback PublicationDate: 2017-01-01

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	**Fiber Optic Communications: Fundamentals and Applications**	Shivakumar M.Jamal Deen	Wiley Estran
2	**Fiber Optic Communications:**	Joseph C.	**5th Edition Palais (9788131717912)**

Department: Electronics and Communication Engineering			Semester:	1
Subject: Adhoc And Wireless Sensor Networks				
Subject Code:	**24DEL163**	**L – T – P - C:**	**3 – 0 – 0–3**	

Sl. No	Course Objectives
1	Describe the concepts of adhoc wireless networks.
2	Analyze different routing protocols of mobile adhoc networks.
3	Apply the energy management policies in routing algorithms.
4	Implement protocols for location based QoS.

Unit	Description	Hours
I	**AD HOC WIRELESS NETWORKS AND MAC INTRODUCTION:** Issues in ad Hoc wireless networks, issues in designing a MAC protocol for ad hoc wireless networks, design goals of a MAC protocols for ad hoc networks, classifications of MAC protocols.	8
II	**ROUTING PROTOCOLS IN AD HOC NETWORKS:** Issues in designing a routing protocol for ad hoc wireless networks, classifications of routing protocols, table driven routing protocol, on-demand routing protocols, hybrid routing protocols, hierarchical routing protocols, and power aware routing protocols.	8
III	**ENERGY MANAGEMENT IN AD-HOC WIRELESS NETWORKS:** Introduction, need for energy management in adhoc networks, battery management schemes-overview of battery charachteristic, device dependent schemes. Energy Efficient Communication in AdHoc Wireless Networks, Ad Hoc Networks Security, Self-Organized and Cooperative Ad Hoc Networking, Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization, Algorithmic Challenges in Ad HocNetworks.	8
IV	**QUALITY OF SERVICE IN AD HOC WIRELESS NETWORKS:** Introduction, issues and challenges in providing QoS in ad hoc networks, classification of QoS solutions, MAC layer solutions, QoS routing protocols, ticket based, predictive location based QoS routing protocols.	8
V	**WIRELESS SENSOR NETWORKS:** Introduction, sensor network architecture, data dissemination, gathering, MAC protocols for sensor networks self-organizing, hybrid TDMA/FDMA, CSMA based MAC, location Discovery.	7

Course Outcomes

Course outcome	Descriptions
CO1	Describe an adhoc network and analyze various technologies associated with it.
CO2	Analyze various transport layer and analyze various protocols associated with it.
CO3	Analyze adhoc & sensor- based networks and compute various parameters associated with it.
CO4	Discuss the challenges in designing routing and transport protocols forwireless Ad-hoc/sensor networks

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3
CO1	3		
CO2		3	
CO3		2	
CO4			3

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Ad Hoc Wireless Networks- Architectures and Protocols	C. Siva Ram Murthy and B. S. Manoj	Pearson Education, 2013.
2	Adhoc & Sensor networks	Stefano Basagni, Silvia Giordano, Ivan Stojmenvic.	IEEE Press, A John Wiley & Sons, Inc., Publication 2004

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Wireless Sensor Networks	Feng Zhao and Leonidas Guibas	Noida: Morgan Kaufman Publishers, 2004.
2	Ad Hoc Mobile Wireless Networks	C. K. Toh	New Delhi: Pearson Education,
3	Wireless Mesh Networking	Thomas Krag and Sebastin Buettrich	Mumbai: O'Reilly

MOOC Course:

https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/
https://archive.nptel.ac.in/courses/106/105/106105160/

Department: Electronics and Communication Engineering			Semester:	1
Subject: Data Compression				
Subject Code:	24DEL164	L – T – P - C:		3 – 0 – 0–3

Sl. No	Course Objectives
1	To introduce the basic concepts, types, techniques and applications of data compression.
2	To develop skills for using recent data compression to solve practical problems in a variety of disciplines.
3	To provide the knowledge of quantization algorithms.
4	To gain the knowledge of coding a sequence.

Unit	Description	Hours
I	Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modelling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.	8
II	The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.	8
III	Coding a sequence: Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPESYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Moveto-front coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.	8
IV	Distortion criteria: Models, Scalar Quantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.	8
V	Advantages of Vector Quantization over Scalar Quantization: The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured Vector Quantizers.	7

Course Outcomes:

Course outcome	Descriptions
CO1	Describe the evolution and fundamental concepts of data compression and coding techniques.
CO2	Apply and compare different static coding techniques (Huffman & Arithmetic coding) for text compression.
CO3	Apply and compare different dynamic coding techniques (Dictionary Technique) for text compression.
CO4	Evaluate the performance of predictive coding technique for Image Compression.

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	1	3	2
CO2	1	1	1
CO3	2	2	3
CO4	3	3	1

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Data Compression	Khalid Sayood	Morgan Kaufmann Publishers
2	Elements of Data Compression	Drozdek,	Cengage Learning

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Data Compression	Khalid Sayood	Second Edition,The Morgan aufmann Series
2	Data Compression	David Salomon	The Complete Reference 4th Edition by, Springer
3	Text Compression	Timothy C	1st Edition by. Bell Prentice Hall

Department: Electronics and Communication Engineering			Semester:	1
Subject: Embedded Systems Lab				
Subject Code:	**24DELLB1**	**L – T – P - C:**		**0 – 0 – 3–1.5**

Sl. No	Course Objectives
1	Understand the implementation of embedded systems with practical experiments.
2	Develop skills in writing and debugging embedded C programs for real-time applications.
3	To provide hands-on experience in designing and implementing advanced embedded systems using micro controllers.
4	To develop proficiency in programming various interfaces and protocols commonly used in embedded systems, such as UART, I2C, PWM, Watchdog timer, and Real-Time Clock (RTC) using LPC2148.

Unit	Description	Hours
1.	Interface a 16x2 LCD with the LPC2128 microcontroller and display a string of text.	
2.	Interface a 4x4 keypad with the LPC2128 microcontroller and display the pressed key on the LCD.	
3.	Generate a square wave using the Timer of the LPC2128 microcontroller.	
4.	Toggle an LED on and off using an external interrupt triggered by a push-button	
5.	Demonstrate the use of the Watchdog Timer to reset the LPC2128 microcontroller.	
6.	Program to send and receive data via UART using LPC2148.	
7.	Program to interface an EEPROM using I2C protocol.	
8.	Program to generate PWM signals using LPC2148.	
9.	Program to configure and use the Watchdog timer.	
10.	Program to interface and read the Real-Time Clock (RTC) using LPC2148.	

Course Outcome:

Course outcome	Descriptions
CO1	Utilize microcontroller features such as Timers, Interrupts, and Watchdog Timers in embedded applications. (L3)
CO2	Demonstrate proficiency in writing and debugging embedded C programs. (L3)
CO3	Develop embedded systems with LPC2148, implementing various interfaces and protocols such as UART, I2C.(L3)

CO4	Develop proficiency in designing and implementing advanced embedded systems using microcontrollers, including programming various interfaces such as PWM, Watchdog timer, and Real-Time Clock (RTC) using LPC2148(L6)

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3
CO1	2	2	3
CO2	2	2	3
CO3			1
CO4	1		

Text Books:

Sl. No.	Title	Authors	Volume and Year of Edition
1.	Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C	Daniel W. Lewis	Morgan Kaufmann, 2015
2.	ARM LPC2148 Based Embedded Systems: Concepts, Designs, and Programming	Sumit Ahuja	Khanna Publishers, 1st Edition, 2018
3.	Embedded Systems: Using Assembly and C	Muhammad Ali Mazidi, Shujen Chen, Sepehr Naimi	Pearson Education, 1st Edition, 2009

Department: Electronics and Communication Engineering		Semester:	2
Subject: Advances in Image Processing			
Subject Code:	**24DEL21**	**L – T – P - C:**	**4 – 0 – 0 – 4**

Sl. No	Course Objectives
1	Understand the remote sensing process and its data management and planning.
2	Learn the principles of the physics of light and its application in remote sensing.
3	Study satellite image processing techniques, including digital image enhancement and classification.
4	Acquire knowledge of geometric correction, image enhancement, and classification methods.
5	Explore advanced image processing techniques such as principal component analysis and current classification methods.

Unit	Description	Hours
I	**The Remote Sensing Process and Physics of Light:** Introduction to the remote sensing process, data management, and planning. Principles of recording the image. Spectral properties of plants, soil, and water in optical wavelengths. Influence of plant structure, moisture content, phenology, and growth cycle on reflectance patterns. Effect of organic matter, mineral content, texture, and moisture content on soil reflectance. (Text Book 1: Chapters 1 and 2)	11
II	**Satellite Image Processing:** Techniques for digital image enhancement and classification. Understanding various indices used in satellite image processing. (Text Book 1: Chapter 3)	10
III	**Geometric Correction and Image Enhancement:** Geometric correction including map projections, selection of ground control points, transform equations, and resampling methods (nearest neighbor, bilinear interpolation, cubic convolution, sinc x). Image enhancement techniques: contrast stretching (linear, bilinear, Gaussian, histogram equalization, and manual), digital filtering in the spatial domain (low-pass, high-pass, high-boost, median, and directional). (Text Book 1: Chapter 4)	10
IV	**Classification Methods:** Classification techniques including density slice, box classification, maximum likelihood, and minimum distance algorithms. Supervised and unsupervised training techniques. Spectral coincident plots and decision tree classification. (Text Book 1: Chapter 5)	10
V	**Advanced Image Processing Techniques:** Principal component analysis and the formation of eigen images. Band arithmetic and masking. De-correlation stretch. Current classification methods in advanced image processing. (Text Book 1: Chapter 6)	11

Course Outcome:

Course outcome	Descriptions
CO1	Understand the remote sensing process and principles of light physics in remote sensing. (L2)
CO2	Apply techniques for digital image enhancement and classification in satellite image processing. (L3)
CO3	Demonstrate geometric correction and various image enhancement techniques. (L3)
CO4	Evaluate different classification methods and advanced image processing techniques. (L4)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3
CO1	2	2	
CO2		3	2
CO3		2	3
CO4	2		2

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Remote Sensing and Image Interpretation	Thomas M. Lillesand and Ralph W. Kiefer	John Wiley & Sons, 7th Edition, 2015

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Digital Image Processing	Rafael C. Gonzalez and Richard E. Woods	Pearson Education, 4th Edition, 2018
2	Fundamentals of Remote Sensing	George Joseph	Universities Press, 2nd Edition, 2005
3	Introductory Digital Image Processing: A Remote Sensing Perspective	John R. Jensen	Pearson Education, 4th Edition, 2015

Department: Electronics and Communication Engineering			Semester:	2
Subject: Advanced computer Architecture				
Subject Code:	24DEL22	L – T – P - C:		4 – 0 – 0 –4

SL.No	Descriptions
1	Apply the concepts and laws of logic design to solve logical problems. (L3)
2	Solve complexity of logical equation using simplification techniques and decomposition methods. (L4)
3	Design logical circuits such as encoder, decoder, sine wave. (L3)
4	Test the digital circuit for faults and design fault free circuit. (L3)

Unit	Description	Hours
I	**Review Of Digital Concepts:** Problem statement to truth tables, combinational logic, logic problems simplification of Boolean functions, K-map, Quine-McCluskey method, Map entered variable. **Logic design:** Analysis of combinational circuits, comparators, data selectors, Encoders – priority encoder, Decoders – BCD to Decimal, seven segment display, Sine generators, Design of high-speed adders – Ripple adder, Carry look ahead adder.	11
II	**Functional Decomposition And Symmetric Functions**:Functional Decomposition, Decomposition by expansion, Test for decomposability, Decomposition charts, Symmetric networks, Properties of symmetric functions, synthesis, complemented variables of symmetry, Identification of symmetric functions.	10
III	**Reliable Design And Fault Diagnosis Hazards:** Fault Detection in Combinational Circuits, Fault-Location Experiments, Boolean Differences,Fault Detection by Path Sensitizing, Detection of Multiple Faults, Failure-Tolerant Design, Quadded Logic.	10
IV	**Introduction To Synchronous Sequential Circuits and Iterative Networks:** Sequential circuits-The finite state model- Memory element and their excitation functions, Synthesis of synchronous sequential circuits, Iterative networks.	10
V	**Capabilities, Minimization, And Transformation of Sequential Machines:** The Finite-State Model, Further Definitions, Capabilities and Limitations of Finite – State Machines, Equivalence and Machine Minimization, Simplification of Incompletely Specified Machines. Structure of Sequential Machines: State Assignments Using Partitions, The lattice of closed partitions, Reduction of the output dependency, Input independence and autonomous clocks.	11

Course Outcomes:

Course outcome	Descriptions
CO1	Apply the concepts and laws of logic design to solve logical problems. (L2)
CO2	Solve complexity of logical equation using simplification techniques and decomposition methods. (L3)
CO3	Design logical circuits such as encoder, decoder, sine wave. (L3)
CO4	Test the digital circuit for faults and design fault free circuit. (L3)

Course Articulation Matrix

CO \ PO	PO1	PO2	PO3
CO1	3	2	
CO2	2	3	
CO3	2	3	2
CO4	2	3	2

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Switching and Finite Automata Theory	ZviKohavi	2nd Edition. Tata McGraw Hill Edition, ISBN-10: 0-07-099387-4
2	Fundamentals of Logic Systems	Charles Roth Jr	Cengage learning, 7th edition, 2013, ISBN-13: 978-1133628477

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Fault Tolerant and fault testable hardware design	Parag K Lala	Prentice Hall Inc. 1985
2	Introductory theory of computer	V. Krishnamurthy	Macmillan Press Ltd, 1983
3	Theory of computer science – Automata, Languages and Computation	Mishra &Chandrasekaran	2nd Edition, PHI, 2004

Department: Electronics and Communication Engineering			Semester:	2
Subject: Real Time Embedded Systems				
Subject Code:	24DEL23		L – T – P - C:	4 – 0 – 0 – 4

Sl. No	Course Objectives
1	Introduce the fundamental concepts of Real Time Operating Systems and the real time embedded system
2	Apply concepts relating to operating systems such as Scheduling techniques, Thread Safe Reentrant Functions, Dynamic priority policies.
3	Describe concepts related to Multi resource services like blocking, Deadlock, live lock & soft real-time services.
4	Discuss Memory management concepts, Embedded system components, Debugging components and file system components.

Unit	Description	Hours
I	**Arm Processor and Peripherals** ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.	**10**
II	**Real-Time Systems and Resources**: Brief history of Real Time Systems, A brief history of Embedded Systems. System Resources, Resource Analysis, Real-Time Service Utility, Scheduler concepts, Real-Time OS, State transition diagram and tables, Thread Safe Reentrant Functions. (Text 1: Selected sections from Chap. 1, 2)	**10**
III	**Processing with Real Time Scheduling**: Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies with timing diagrams and problems and issues, Feasibility, Rate Monotonic least upper bound, Necessary and Sufficient feasibility, Deadline –Monotonic Policy, Dynamic priority policies, Alternative to RM policy. (Text 1: Chap. 2,3,7)	**10**
IV	**Memory and I/O**: Worst case execution time, Intermediate I/O, Shared Memory, ECC Memory, Flash file systems. Multi-resource Services, Blocking, Deadlock and live lock, Critical sections to protect shared resources, Missed deadline, QoS, Reliability and Availability, Similarities and differences, Reliable software, Available software. (Text 1: Selected topics from Chap. 4,5,6,7,11).	**10**
V	**Firmware Components**: The 3 firmware components, RTOS system software mechanisms, Software application components. Debugging Components, Exceptions, assert, Checking return codes, Single-step debugging, Test access ports, Trace Ports. (Text 1: Selected topics	**12**

Course Outcomes:

Course outcome	Descriptions
CO1	Develop programs for real time services, firmware and RTOS, using the fundamentals of Real Time Embedded System, real time service utilities, debugging methodologies and optimization techniques.
CO2	Select the appropriate system resources (CPU, I/O, Memory, Cache, ECC Memory, Microcontroller/FPGA/ASIC to improve the system performance.
CO3	Apply priority based static and dynamic real time scheduling techniques for the given specifications.
CO4	Analyze deadlock conditions, shared memory problem, critical section problem, missed deadlines, availability, reliability and QoS.

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2		2
CO3	2		3
CO4	-	2	3

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Embedded System-Architecture, Programming, Design	Rajkamal,	Mc Graw Hill, 2013.
2	"Real-Time Embedded Systems and Components",	Sam Siewert,	Cengage Learning India Edition, 2007.
3	Embedded/Real Time Systems, Concepts, Design and Programming, Black Book,	Dr. K.V.K.K Prasad	Dream Tech Press, New edition, 2010.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Real Time System", 2.	James W S Liu	Pearson education, 2008.
2	"Programming for Embedded Systems",	Dream Tech Software Team,	John Wiley, India Pvt. Ltd., 2008.

Department: Electronics and Communication Engineering		Semester:	2
Subject: Error Control Coding			
Subject Code:	**24DEL24**	**L – T – P - C:**	**4 – 0 – 0 – 4**

Sl. No	Course Objectives
1	Understand the use of linear algebra for error control coding.
2	Acquire the knowledge of Linear block code, cyclic code, BCH code and convolutional codes
3	Learn several error control codes to achieve error detection and correction in data transmission systems.

Sl.No	Description	Hours
I	**Introduction to algebra:** Groups, Fields, binary Fields arithmetic, Construction of Galois Fields GF (2^m) and its properties, Computation using Galois Fields GF (2^m) arithmetic, Vector spaces and Matrices.**Linear block codes:** Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Error detecting and error correcting capabilities, Standard array and syndrome decoding, decoding circuits, Hamming codes, Reed-Muller codes.	8
II	**Cyclic codes:** Introduction, Generator and parity check polynomials, Encoding using multiplication circuits, Systematic cyclic codes - Encoding using feedback shift register circuits, generator matrix for cyclic code, Syndrome computing and detection, Meggitt decoder, Error trapping decoding, Golay codes.	8
III	**BCH codes**: Binary and Non binary primitive BCH codes, Decoding procedures, Reed -Solomon codes, decoding of non-binary BCH and RS codes using the Berlekamp - Massey Algorithm. **Majority Logic decodable codes:** One step and two step majority logic decoding, Multiple-step majority logic decoding.	8
IV	**Convolution codes:** Systematic and Nonsystematic Encoding of convolutional codes, Viterbi decoding algorithm, Stack and Fano sequential decoding algorithms.	8
V	**Concatenated codes and Turbo codes:** Single level concatenated codes, Concept of interleaving, Introduction to Turbo coding and their distance properties, design of Turbo codes.	7

Course outcome	Descriptions **Course Outcomes:**
CO1	Relate and use linear algebra concepts in designing error control codes. Design random error correcting codes mathematically and encoder/decoder design for varying message lengths and also design one step and two step Majority logic decodable codes with probability of error as the performance parameter.
CO2	Design multiple error correcting codes such as Reed Muller, Reed Solomon codes, BCH (binary and non binary) and appropriate decoders with probability of error as the performance parameter.

CO3	Design systematic and non- systematic Convolution encoders and Viterbi decoders, Stack and Fano sequential decoding algorithms with probability of error as the performance parameter.
CO4	Analyse and Design single/multiple level concatenated codes, burst error correcting codes and analyze turbo codes.

Course Atriculation Matrix

CO \ PO	PO1	PO2	PO3
CO1	**2**		**2**
CO2	**3**		**3**
CO3	**2**		**2**
CO4	**3**		**2**

Text Books:

Sl.No	Title	Authors	Volume and Year of Edition
1	Error control coding	Shu Lin and Daniel J. Costello. Jr	Pearson, Prentice Hall, 2nd edition, 2004

Reference Books:

Sl.No	Title	Authors	Volume and Year of Edition
1	Theory and practice of error control codes	Blahut. R. E,	Addison Wesley, 1984.

Department: Electronics and Communication Engineering			Semester:	2
Subject: Digital System Design using Verilog				
Subject Code:	**24DEL251**	**L – T – P - C:**		**3 – 0 – 0–3**

Sl. No	Course Objectives
1	Understand the concepts of Real-world circuits, Models and Design Methodology.
2	Discuss the Combinational Circuits and Sequential Circuits, its verilog code and its Verification.
3	Study the design and operation of semiconductor memories used in application specific digital system.
4	Design of processor basics and I/O controllers used in embedded systems.

Unit	Description	Hours
I	**Introduction and Methodology:** Digital Systems and Embedded Systems, Binary Circuit Elements, Real-World Circuits, Models, Design Methodology. **Combinational Basics:** Boolean Functions and Boolean Algebra, Binary Coding, Combinational Components and Circuits, Verification of Combinational Circuits.	**8**
II	**Number Basics**: Unsigned and Signed Integers, Fixed and Floating-point Numbers. **Sequential Basics**: Storage elements, Counters, Sequential Data paths and Control, Clocked Synchronous Timing Methodology	8
III	**Memories:** Concepts, Memory Types, Error Detection and Correction. Implementation Fabrics: ICs, PLDs, Packaging and Circuit Boards, Interconnection and Signal Integrity	8
IV	**Processor Basics:** Embedded Computer Organization, Instruction and Data, Interfacing with memory. **I/O interfacing:** I/O devices, I/O controllers, Parallel Buses.	7
V	Processor Design and System Development: Design of Processor Architectures: Functional Units for Addition, Subtraction and Multiplication (overview). Interfacing Concepts: Embedded Computer Organization, Instruction and Data, Memory Interfacing. I/O Interfacing: I/O devices, I/O controllers, Parallel Buses, Serial Transmission	8

Course Outcomes:

Course outcome	Descriptions
CO1	Interpret the knowledge of Digital Systems and Embedded Systems(L2)
CO2	Model digital systems in Verilog HDL at different levels of abstraction(L3)
CO3	Design of memories using Verilog HDL(L3)
CO4	Outline the Concepts of Design methodology and I/O Controllers used in embedded system(L2)

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	2		1
CO2	3		2
CO3	3		3
CO4	3		3

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital Design: An Embedded Systems Approach Using VERILOG	Peter J. Ashenden	Elsevier, 2010.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	A Verilog HDL Primer	J. Bhasker	Second Edition, Star Galaxy, 2005
2	A Verilog Synthesis: A Practical Primer	J. Bhasker	Star Galaxy, 1998

Department: Electronics and Communication Engineering		Semester:	2
Subject: Automotive Electronics			
Subject Code:	**24DEL252**	**L – T – P - C:**	**4 – 0 – 0 – 4**

Sl. No	Course Objectives
1	Providing an overview of automotive network systems.
2	Exposing students to the aspects of design, development, application, and performance issues associated with automotive network systems.
3	Introducing students to various automotive networking protocols.
4	Developing skills to design and implement networking protocols in automotive systems.
5	Enhancing understanding of safety-critical applications using automotive networking protocols.

Unit	Description	Hours
I	**Introduction to Automotive Networking and General Purpose Protocols:** Overview of data communication and networking – need for in-vehicle networking – layers of OSI reference model – multiplexing and de-multiplexing concepts – vehicle buses. Overview of general-purpose networks and protocols – Ethernet, TCP, UDP, IP. Protocol for Low Data Rate Applications and Time Triggered Protocol: LIN standard overview – workflow concept – applications – LIN protocol specification – signals	**7**
II	**Frame transfer** – frame types – schedule tables – task behavior model – network management – status management. Introduction to CAN open – TTCAN – Device Net – SAE J1939.	**8**
III	**Protocol for Medium Data Rate Applications**: Overview of CAN – fundamentals – message transfer – frame types – error handling – fault confinement – bit time requirements.	**8**
IV	**Protocol for Infotainment**: MOST – overview of data channels – control channel – synchronous channel – asynchronous channel – logical device model – functions – methods – properties – protocol basics – network section – data transport – blocks – frames – preamble – boundary descriptor.	**8**
V	**Protocols for Safety Critical Applications**: Flex Ray – introduction – network topology – ECUs and bus interfaces – controller host interface and protocol operation controls – media access control and frame and symbol processing – coding/decoding unit.	**8**

Course outcome:

Course outcome	Descriptions
CO1	Illustrate the basics of automotive networking and protocols.
CO2	Comprehend the general protocols and their usage in the automotive sector.
CO3	Design and implement CAN and LIN protocols for various automotive applications.
CO4	Understand and apply time-triggered, media-oriented, and safety-critical protocols in automotive systems.

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3
CO1	3	2	2
CO2	2	3	2
CO3	2	2	3
CO4	2	3	2

Text Books:

Sl.No	Text Book title	Author	Volume and Year of Edition
1	Automotive In-Vehicle Networks	J. Gabrielleen	John Wiley & Sons, Limited, 2016

Reference Books:

Sl.No	Text Book title	Author	Volume and Year of Edition
1	Bosch Automotive Networking	Robert Bosch	Bentley Publishers, 2007
2	In-Vehicle Networks	Society of Automotive Engineers	2015
3	Automotive Electronics Handbook	Ronald K. Jurgen	McGraw-Hill Inc., 1999
4	Communication Networks: Fundamental Concepts and Key Architectures	Indra Widjaja, Alberto Leon-Garcia	McGraw-Hill College, 1st edition, 2000

Department: Electronics and Communication Engineering		Semester:	2
Subject: Intelligent IoT System Design and Architecture			
Subject Code:	**24DEL253**	**L – T – P - C:**	**3-0-0-3**

Sl.No.	Course Objectives
1.	Introduce the fundamentsals, evolution and enabling technologies of IOT.
2.	Understand IoT architectures, communication models and security through case studies.
3.	Explore edge computing, cloud computing, real-time data management and machine learning integration in IoT systems.
4.	Examine advanced IoT topics, including architectures, standards and applications in smart cities, healthcare and Industry 4.0

Unit	Description	Hours
I	**Introduction to IoT:** Evolution of IoT, IoT Characteristics, IoT Enabling Technologies, planning for an IoT Solution, IoT Use Case Development: Needs and Goals. (Text1: Chapters 1-3)	**8**
II	**IoT Architecture and Design** IoT Architecture Reference Model, Functional Blocks of IoT, Communication Models, Security Models, Case Studies. (Text1: Chapters 2-5)	**8**
III	**Computing in IoT** Edge Computing for IoT, Cloud Computing for IoT, Data Management in IoT, Real-Time Processing, Case Studies. (Text1: Chapters 5-6)	**8**
IV	**Machine Learning and Analytics in IoT** Introduction to Machine Learning for IoT, Data Analytics in IoT, Integration of ML Models, Predictive Analytics, Case Studies. (Text1: Chapter 7)	**8**
V	**Advanced Topics and Applications** Service-Oriented Architecture, Event-Driven Architecture, IoT Standards, Applications in Smart Cities, Healthcare, and Industry 4.0, Future Trends and Research Directions. (Text1:Chapter 8)	**7**

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the fundamental architecture of IoT systems.
CO2	Design and implement intelligent IoT solutions, integrating machine learning models for data analysis.
CO3	Utilize edge and cloud computing effectively in IoT projects.
CO4	Address security and privacy concerns in IoT design.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3
CO1	1	-	-
CO2	3	2	-
CO3	3	2	2
CO4	3	2	3

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1.	Internet of Things: A Hands-On Approach	Arshdeep Bahga, Vijay Madisetti	1st Edition, 2014
2.	Architecting the Internet of Things	Dieter Uckelmann, Mark Harrison, Florian Michahelles	1st Edition, 2011

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1.	Edge Computing: From Hype to Reality	Fadi Al-Turjman	1st Edition, 2018
2.	Fog and Edge Computing: Principles and Paradigms	Rajkumar Buyya, Satish Narayana Srirama	1st Edition, 2019
3.	Building the Internet of Things	Maciej Kranz	1st Edition, 2016
4.	Internet of Things: Architecture and Design Principles	Raj Kamal	1st Edition, 2017

Department: Electronics and Communication Engineering			Semester:	2
Subject: System on chip Design				
Subject Code:	24DEL254		L – T – P - C:	3 – 0 – 0 – 3

Sl. No	Course Objectives
1	Learn the various benefits involved in SoC design and typical design goals related to SoC design.
2	Apply the concepts of embedded memories with interconnect architectures for SoC design.
3	Understand the concepts related to SoC design flow, co-design and various power management issues.

Unit	Description	Hours
I	**Motivation for SoC Design** Review of Moore's law and CMOS scaling, benefits of System-on-Chip integration in terms of cost, power, and performance, comparison of System- on-Board, System-on-Chip and System-in-Package, typical goals in SoC design – cost reduction, power reduction, design effort reduction, performance maximization, productivity gap issues and the ways to improve the gap – IP based design and design reuse.	07
II	**Embedded Processors** Microprocessors, Microcontrollers, DSP and their selection criteria, review of RISC and CISC instruction sets, Von-Neumann and Harward architectures and interrupt architectures	08
III	**Embedded Memories** Scratchpad memories, Cache memories, Flash memories, Embedded DRAM, topics related to cache memories, Cache coherence, MESI protocol.	08
IV	**Interconnect architectures for SoC** Bus architecture and its limitations, Network on Chip (NoC) topologies, packet switching and circuit switching, routing algorithms, static and dynamic routing, distributed and source routing, minimal and non-minimal routing, flow control, quality of service and NoC architectures.	08
V	**CASE STUDIES** 1. T. N. Tan, P. Duong-Ngoc, T. X. Pham and H. Lee, "Novel Performance Evaluation Approach of AMBA AXI-Based SoC Design," 2021 18th International SoC Design Conference (ISOCC), Jeju Island, Korea, Republic of, 2021, pp. 403-404, doi: 10.1109/ISOCC53507.2021.9613920. 2. J. Yue, W. Sun, H. Yang and Y. Liu, "Challenges and Opportunities of Energy-Efficient CIM SoC Design for Edge AI Devices," 2021 18th International SoC Design Conference (ISOCC), Jeju Island, Korea, Republic of, 2021, pp. 197-198, doi: 10.1109/ISOCC53507.2021.9613846. 3. K. Kang et al., "Seamless SoC Verification Using Virtual Platforms: An Industrial Case Study," 2019 Design, Automation & Test in Europe Conference & Exhibition (DATE), Florence, Italy, 2019, pp. 1204-1205, doi: 10.23919/DATE.2019.8715128. 4. B. Khailany et al., "INVITED: A Modular Digital VLSI Flow for High-Productivity SoC Design," 2018 55th ACM/ESDA/IEEE Design Automation Conference (DAC), San Francisco, CA, USA, 2018, pp. 1-6, doi: 10.1109/DAC.2018.8465897.	08

Course Outcomes:

Course outcome	Descriptions

CO1	Interpret the different challenges involved in design of SoC and compare different design configurations such as System-on-Board and System-in-Package and case studies related to soc design(L2).
CO2	Explain various embedded processors, memory architectures and hardware accelerators related to SoC design. (L2).

CO3	Infer NOC with mixed signal components(L3).
CO4	Analyse the performance of various NoC architecture (L4).

Course Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3
CO1	**3**		**3**
CO2	**2**		**2**
CO3	**3**		**3**
CO4	**3**		**3**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1.	On-Chip Communication Architectures: System on Chip Interconnect	Sudeep Pasricha and NikilDutt	Morgan Kaufmann Publishers © 2008
2.	Networks on Chips: Technology and Tools	Luca Benini and Giovanni De Micheli	Morgan Kaufmann Publishers © 2006
3.	Embedded Systems: A Contemporary Design Tool	James K. Peckol	Wiley Student Edition, 2007.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to system on package sop-Miniaturization of the entire System	Rao R. Tummala, Madhavan Swaminathan	McGraw-Hill-2008
2	Transaction Level Modeling with System C: TLM Concepts and Applications for Embedded Systems	Frank Ghenassia	Springer © 2005

3	Surviving the SOC revolution: a guide to platform-based design	Henry Chang	Kluwer (Springer), 1999

Department: Electronics and Communication Engineering		**Semester:**	**2**

Subject: Simulation Modeling and Analysis			
Subject Code:	**24DEL261**	**L – T – P - C:**	**3 – 0 – 0–3**

Sl. No	Course Objectives
1	Define the basics of simulation modeling and replicating practical situations in organizations.
2	Generate random numbers and random variants using different techniques.
3	Develop simulation models using heuristic methods.
4	Analyze simulation models using input analyzers and output analyzers.
5	Explain verification and validation of simulation models.

Unit	Description	Hours
I	Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.	8
II	General Principles: Concepts in discrete-event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling. Random Numbers: Properties, Generation methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.	8
III	Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log-normal Distributions, convolution methods- Erlang distribution, Acceptance-Rejection Technique. Optimization Via Simulation: Meaning, difficulty, Robust Heuristics, Random Search.	8
IV	Analysis of Simulation Data: Input Modelling: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. Verification and Validation of Model: Model Building, Verification, Calibration and Validation of Models.	8
V	Output Analysis: Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations. Simulation Softwares: Selection of Simulation Software, Simulation packages, Trend in Simulation Software.	7

Course Outcomes:

Course outcome	Descriptions
CO1	Define the basics of simulation modeling and principles in practical situations (L2).
CO2	Generate and apply techniques for random numbers and variates in simulation models (L3).
CO3	Develop and demonstrate simulation models using heuristic methods (L3).
CO4	Analyze simulation models using input and output analyzers, and verify and validate models (L4).

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3
CO1	2	2	
CO2		3	2
CO3		2	3
CO4	2		2

Text Books:

Sl. No.	Title	Author	Volume and Year of Edition
1	VLSI Digital Signal processing, John- Wiley	K.K Parhi	1999
2	Digital Signal Processors	B.Venkatramani, M.Bhaskar	Tata McGraw-Hill, 2002.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Simulation Modeling & Analysis	Averill M. Law et al.	McGraw Hill International Editions, 2000
2	System Simulation with Digital Computer	Narsingh Deo	PHI publication, 2004

Department: Electronics and Communication Engineering			Semester:	2
Subject: MEMS (MICRO ELECTRO MECHANICAL SYSTEMS)				
Subject Code:	**24DEL262**		**L – T – P - C:**	**3 – 0 – 0–3**

Sl. No	Course Objectives
1	Familiarize with MEMS Materials and Scaling Laws in Miniaturation.
2	Revive various concepts of engineering mechanics and thermo fluid engineering for Microsystems Design. Also study the Microsystems Fabrication Process.
3	Understand the concepts of Microsystems Design, Assembly and Packaging.
4	To explore on various Case Study of MEMS Devices.

Unit	Description	Hrs
I	**Overview of MEMS and Microsystems, Mems Materials and Scaling Laws in Miniaturization:** Microsystems and microelectronics, Microsystems and miniaturization, Working principle of micro system - Micro sensors, Micro actuators, MEMS with Micro actuators. Materials for MEMS - Substrate & wafer, Si as a substrate material, Si compound, Si Piezo-resistors, polymers packaging Materials. Scaling Laws in Miniaturization-Scaling in Geometry, scaling in Electrostatic Forces, scaling in Electromagnetic Forces, scaling in Electricity.	8
II	**Engineering Mechanics and Thermofluidic Engineering for Microsystems Design:** Atomic structure of matter, Ions and ionization, Molecular theory of matter and intermolecular forces, Diffusion process, Thermo mechanical analysis, Overview of finite element analysis. Thermo fluid Engineering-Characteristics of Moving Fluids, The Continuity Equation, The Momentum Equation.	8
III	**Microsystems Fabrication Process:** Fabrication Process - Photolithography, Ion implantation, Oxidation, Chemical vapor deposition (CVD), Physical vapor deposition, Deposition by Epitaxy, Etching. Manufacturing Process - Bulk Micromachining, Surface Micromachining and LIGA Process.	8
IV	**Microsystems Design, Assembly and Packaging:** Micro system Design - Design consideration, process design, Mechanical design using MEMS. Mechanical packaging of Microsystems, interfacings in Microsystems packaging, packaging technology, selection of packaging materials.	8
V	**Case Study of Mems Devices:** Case study on strain sensors, Temperature sensors, Pressure sensors, Humidity sensors, Accelerometers, Gyroscopes, RF MEMS Switch, phase shifter, and smart sensors. Case study of MEMS pressure sensor Packaging.	7

Course Outcomes

Course outcome	Descriptions
CO1	Aanalyze the fundamentals of MEMS and its Design methodology. (L3)
CO2	Compare various Mechanical & Electronics Sensors and its applications. (L2)
CO3	Distinguish the various bonding and packaging techniques in MEMS(L4).
CO4	Interpret the scaling issues in MEMS. (L1)

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3
CO1	3		
CO2		1	
CO3	1		
CO4			2

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	MEMS and Microsystems: design , manufacture, and nanoscale Engineering	Tai-Ran Hsu, John Wiley and Sons, Inc., Hoboken	New Jersey, 2008. 2nd Edition.
2	Foundations of MEMS	Chang Liu	Pearson Indian Print, 1st Edition, 2012.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	RF MEMS - Theory Design and Technology	Gabriel M Rebeiz	John Wiley & Sons, 2004.
2	Micro sensors MEMS and smart devices	Julian W Gardner	John Wiley and sons Ltd, 2001.

Department: Electronics and Communication Engineering			Semester:	2
Subject: Pattern Recognition and Machine Learning				
Subject Code:	**24DEL263**	**L – T – P - C:**	**3 – 0 – 0–3**	

Sl. No	Course Objectives
1	Learn the concepts of Probability theory, random variables, joint distribution and density function.
2	Acquire the knowledge of various clustering methods, neural networks, Bayesian techniques and instant based learning.
3	Understand learning and decision trees.
4	Study the analytical learning and reinforced learning

Unit	Description	Hours
I	**Introduction**: Probability Theory, Model Selection, The Curse of Dimensionality, Decision Theory, Information Theory **Distributions**: Binary and Multinomial Variables, The Gaussian Distribution, The Exponential Family,Nonparametric Methods (Ch. 1, 2).	8
II	**Supervised Learning** **Linear Regression Models:** Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison **Classification & Linear Discriminant Analysis:** Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Mode (Ch. 3, 4).	8
III	**Supervised Learning** **Kernels:** Dual Representations, Constructing Kernels, Radial Basis Function Network, Gaussian Processes **Support Vector Machines:** Maximum Margin Classifiers, Relevance Vector Machines **Neural Networks:** Feed-forward Network, Network Training, Error Backpropagation (Ch. 5, 6, 7).	8
IV	**Unsupervised Learning** **Mixture Models:** K-means Clustering, Mixtures of Gaussians, Maximum likelihood, EM for Gaussian mixtures, Alternative View of EM. **Dimensionality Reduction:** Principal Component Analysis, Factor/Component Analysis, Probabilistic PCA, Kernel PCA, Nonlinear Latent Variable Models (Ch. 9, 12).	8
V	**Probabilistic Graphical Models:** Bayesian Networks, Conditional Independence, Markov Random Fields, Inference in Graphical Models, Markov Model, Hidden Markov Models (Ch.8, 13).	8

Course Outcomes:

Course outcome	Descriptions
CO1	Recall the problems for machine learning and select the either supervised, unsupervised or reinforcement learning. (L2)
CO2	Apply the knowledge of probability to statistical and non-parametric decision making (L3)
CO3	Extend the principles of clustering approaches, ANN, Bayes classifier to simple machine learning problems. (L3)
CO4	Analyze classification problems and estimate classifier performance. (L3)

Course Atriculation Matrix

CO \ PO	PO1	PO2	PO3
CO1	1		1
CO2	2		
CO3	2	1	
CO4	2		1

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Pattern Recognition and Machine Learning	Christopher M Bishop	Springer 978 -0-387-31073-2 2009
2	Pattern Recognition and Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	Pearson 978 -93-325- 4979-1

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Pattern Recognition	Konstantinos Koutroumbas Sergios Theodoridis	Academic Press 978 -1-597- 49272-0 2008
2	Pattern Classification	Richard O. Duda, Peter E. Hart, David G. Stork	Wiley 978-81265- 1116-7 2009
3	Machine Learning	Tom M. Mitchell	McGraw Hill Education ISBN- 13:978-1- 25-909695-2 2016

Department: Electronics and Communication Engineering		Semester:	2
Subject: Wavelet Transform And Its Applications			
Subject Code:	**24DEL64**	**L – T – P - C:**	**3 – 0 – 0–3**

Sl. No	Course Objectives
1	Understand the fundamental concepts of wavelet transforms.
2	Analyze signals and images using continuous and discrete wavelet transforms.
3	Apply wavelet-based techniques for feature extraction, denoising, and compression.
4	Explore applications of wavelets in diverse fields like signal processing, image processing, and machine learning.

Unit	Description	Hours
I	**Continuous Wavelet Transform:** Introduction to Wavelet Transforms (WT): Motivation and basic concepts. Continuous time frequency representation of signals, The Windowed Fourier Transform, Uncertainty Principle and time frequency tiling, Wavelets, specifications, admissibility conditions, Continuous wavelet transform, CWT as a correlation, CWT as an operator, Inverse CWT	8
II	**Discrete wavelet Transform:** Approximations of vectors in nested linear vector spaces, Example of an MRA, Formal definition of MRA, Construction of genera orthonormal MRA, a Wavelet basis for MRA, Digital filtering interpretations- Decomposition and Reconstruction filters, examples of orthogonal basis generating wavelets, interpreting orthonormal MRA for Discrete time signals, Mallat algorithm Filter bank implementation of DWT	8
III	**Alternative wavelet representations**- Biorthogonal Wavelets: biorthogonality in vector space, biorthogonal wavelet bases, signal representation using biorthogonal wavelet system, advantages of biorthogonal wavelets, biorthogonal analysis and synthesis, Filter bank implementation, Two dimensional Wavelets, filter bank implementation of two-dimensional wavelet transform.	8
IV	**Lifting scheme:** Wavelet Transform using polyphase matrix factorization, Geometrical foundations of the lifting scheme, lifting scheme in the z- domain, mathematical preliminaries for polyphase factorization, Dealing with Signal Boundary	7
V	**Applications:** Image Compression: EZW Coding, SPIHT, Wavelet Difference Reduction Compression Algorithm, Denoising, speckle removal, edge detection and object isolation, audio compression, communication applications – scaling functions as signalling pulses, Discrete Wavelet Multitone Modulation. Beyond Wavelet: Ridge lets and curve lets: Ridge let transform and Digital Curve let transform, Curve let construction, Properties and applications.	8

Course Outcomes:

Course outcome	Descriptions
CO1	Ability to apply Wavelet Transforms in signal processing tasks effectively.
CO2	Proficiency in implementing various wavelet transform techniques for image and audio compression.
CO3	Understanding of alternative wavelet representations and their advantages in signal analysis
CO4	Competence in applying wavelet-based modulation techniques in communication systems

Course Atriculation Matrix

CO / PO/PSO	PO1	PO2	PO3
CO1	3	2	3
CO2	3	3	2
CO3	3	2	3
CO4	2	2	3

Text Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Wavelet Transforms –Introduction and applications	Raghuveer M. Rao and Ajit S. Bopardikar	Pearson Education, 2008
2	Insight into Wavelets from Theory to practice	K.P Soman, K. I. Ramachandran	PHI, 2006
3	Fundamentals of Wavelets: Theory, Algorithms and Applications	J C Goswamy and A K Chan	Wiley Inderscience Publications, John Wiley and Sons, 1999.

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Wavelet Transforms"	M. Rao and Ajit K. Bopardikar	
2	"A Wavelet Tour of Signal Processing"	Stéphane Mallat	

Department: Electronics and Communication Engineering		Semester:	2
Subject: Image Processing Lab			
Subject Code:	**24DELLB2**	**L – T – P - C:**	**0 – 0 – 3–1.5**

Sl. No	Course Objectives
1	Understand and implement basic image processing techniques.
2	Learn to manipulate and enhance images using various filtering and transformation methods.
3	Develop skills in advanced image processing techniques including compression and edge detection.
4	Gain practical experience in analyzing and improving image quality through different algorithms.

Unit	Description	Hours
1	Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)	
2	Implementation of Relationships between Pixels	
3	Implementation of Transformations of an Image	
4	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization	
5	Display of bit planes of an Image	
6	Display of FFT (1-D & 2-D) of an image	
7	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image	
8	Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)	
9	Implementation of image sharpening filters and Edge Detection using Gradient Filters	
10	Image Compression by DCT, DPCM, HUFFMAN coding	
11	Implementation of image restoring techniques	
12	Implementation of Image Intensity slicing technique for image enhancement	
13	Canny edge detection Algorithm	

Course outcome	Descriptions
CO1	Simulate and display various types of images and their transformations. (L2)
CO2	Apply filtering techniques for image smoothening and sharpening. (L3)
CO3	Analyze and enhance image quality through histogram techniques and contrast stretching. (L3)
CO4	Implement advanced image processing techniques including compression and edge detection. (L4)

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3
CO1	2	2	3
CO2	2	3	2
CO3	3	2	2
CO4	3	3	2

Text Books:

Sl. No.	Title	Authors	Volume and Year of Edition
1	Digital Image Processing	Rafael C. Gonzalez and Richard E. Woods	Pearson, 4th Edition, 2018
2	Image Processing: Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac, Roger Boyle	Cengage Learning, 4th Edition, 2015

Reference Books:

Sl. No.	Title	Authors	Volume and Year of Edition
1	Fundamentals of Digital Image Processing	Anil K. Jain	Pearson, 1st Edition, 1989
2	Practical Image and Video Processing Using MATLAB	Oge Marques	Wiley-IEEE Press, 1st Edition, 2011