ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC Grade)

ಕ್ರಮಾಂಕ/No. : MU/ACC/CR.24/2025-26/A2

ಕುಲಸಚಿವರಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199
ದಿನಾಂಕ/Date:31.07.2025

NOTIFICATION

Sub: Revised syllabus of M.Sc. in Electronics Programme.

Ref: Academic Council approval vide agenda No.:ಎಸಿಸಿ:ಶೈ.ಮ.ಸಾ.ಸ.1:1 (2025-26) dtd 18.07.2025.

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The revised syllabus of M.Sc. in Electronics Programme which has been approved by the Academic Council at its meeting held on 18.07.2025 is hereby notified for implementation with effect from the academic year 2025-26 and onwards.

Copy of the Syllabus shall be downloaded from the University Website (www.mangaloreuniversity.ac.in)

REGISTRAR

To,

1. The Registrar (Evaluation), Mangalore University.
2. The Chairman, UG and PG Combined Board of Studies in Electronics, Dept. of Electronics, Mangalore University.
3. The Chairman, Dept. of Electronics, Mangalore University.
4. The Principals of the College concerned.
5. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
6. The Director, DUIMS, Mangalore University – with a request to publish in the website.
7. Guard File.

MANGALORE UNIVERSITY

Syllabus and Scheme of Examinations for the

M. Sc. Electronics Degree Programme

Choice Based Credit System

DEPARTMENT OF POST-GRADUATE

STUDIESAND RESEARCH IN ELECTRONICS

MANGALAGANGOTHRI - 574 199

JULY 2024

PROGRAMME LEARNING OBJECTIVES (LOs):

The M.Sc. Electronics Degree programme provides a rigorous training that combines theoretical and practical knowledge in Electronics. It specializes in focused areas which are the trends in the Electronics industry like VLSI, AI & ML, Signal Processing, Embedded System design etc. The graduates will acquire the skill sets where Electronics Technology can be applied to various other disciplines.
The Learningobjectives of this programme are:

PLO1: Acquire the skill sets as Electronics professionals for conducting research or designing, developing or implementing Electronics Technology in various technical areas of Electronics.
PLO2: Utilize knowledge and skills in Electronics effectively for improving the society.
PLO3: Use new technical advancements of Electronics to contribute to the subject / profession.

PROGRAMME OUTCOMES (POs):

The curriculum designed for the M. Sc. Electronics degree prepares the students for the positions as Electronics scientists, Electronics engineers and Academicians in the Electronics and Communication as well as Information Technology for the Industry and Government sectors. The main objectives of the curriculum are to impart students with an understanding of the Hardware, Software and problem solving skills through practical approach and to develop proficiency in the field of Electronics and Computers applications and to prepare them for continued professional development.

PROGRAMME OBJECTIVES:

- To impart quality education to the students so that they acquire knowledge in Electronics Technology.
- To provide students with the fundamental skills of different domains in Electronics and to enhance the knowledge and understanding of key concepts of Electronics.
- To equip students with advanced Scientific and Technological capabilities for analyzing and tackling the issues and problems in the field of Electronics.
- To inculcate skill sets for the design and analysis of Electronic Technology.
- To develop self and continuous learning and practice professional ethics for societal benefits.
- To provide students with skills that enables them to get employment in Industries or pursue higher studies/ research assignments or turn as entrepreneurs.

PROGRAMME OUTCOMES:

- Understand comprehensively the entire range of Electronic Technology the state-of art and advanced electronic systems.
- Identify, formulate, and solve problems in the area of Electronics.

- Design and manage Electronic Systems or Processes that conforms to a given specification within ethical and economic constraints
- Ability to use Modern Tools/Techniques in solving problems in the field of Electronics Technology.
- Function effectively as an individual and as a member in diverse teams and in multidisciplinary settings
- Excel in their professional endeavors through self-education.

PROGRAMME SPECIFIC OUTCOMES (PSO):

- **Scientific Temper:** To inculcate the temperament required to pursue a scientific discipline with all the basic pillars of science understood, namely, Theory, Experiment and Computation
- **Mathematical Rigour :** To incorporate the methodical way of dealing with the various branches of Electronics through the application of Mathematics
- **Critical Thinking:** To critically evaluate various scientific and engineering problems through the prism of creative and parallel thinking.
- **Logical Analysis:** To develop a strong logical and analytical mind in students that shall make them good programmers and trouble shooters.
- **Active Learning:** To cultivate a strong base for the active learning with interactive classes and make the students lifelong learners, which is an important demand of the IT and Electronics market place.
- **Entrepreneurship:** To cultivate the spirit of entrepreneurship and to motivate the students to become their own masters, thus becoming job creator‟s rather than job seekers.

I SEMESTER M. Sc. Electronics							
Subject Code	**Subjects**	**Hours/ Week**	**Duration of exams (Hrs)**	**Marks & Credits**			
				IA	**Exam**	**Total**	**Credits**
HARD CORE							
ELH 401	Digital System Design	4L	3	30	70	100	4
ELH 402	Microcontrollers and PIC	4L	3	30	70	100	4
ELH 403	Basic VLSI Design	3L	3	30	70	100	3
SOFT CORE (Any Two can be opted)							
ELS 404	Verilog HDL	3L	3	30	70	100	3
ELS 405	Power Electronics	3L	3	30	70	100	3
ELS 406	Computer Architecture	3L	3	30	70	100	3
ELS 407	Python Programming	3L	3	30	70	100	3

PRACTICALS							
ELP 411	Digital Design using Verilog	6H	3	30	70	100	3
ELP 412	Microcontroller Lab	6H	3	30	70	100	3
	Total	**29**	**21**	**210**	**490**	**700**	**23**

II SEMESTER M. Sc. Electronics							
Subject Code	**Subjects**	**Hours/ Week**	**Duration of exams (Hrs)**	**Marks & Credits**			
				IA	**Exam**	**Total**	**Credits**
HARD CORE							
ELH 451	Digital Signal Processing	4L	3	30	70	100	4
ELH 452	Digital and Wireless Communication	4L	3	30	70	100	4
ELH 453	AI and Machine Learning	3L	3	30	70	100	3
SOFT CORE (Any Two can be opted)							
ELS 454	Embedded System Design	3L	3	30	70	100	3
ELS 455	Microwave Devices	3L	3	30	70	100	3
ELS 456	Low Power VLSI	3L	3	30	70	100	3
ELS 457	Internet of Things	3L	3	30	70	100	3
PRACTICALS							
ELP 461	AI/ML Lab	6H	3	30	70	100	3
ELP 462	Digital Signal Processing Lab	6H	3	30	70	100	3
OPEN ELECTIVE							
ELE 459	Introduction to Artificial Intelligence	3L	3	30	70	100	3*
	Total	**29**	**21**	**210**	**490**	**700**	**23+3***

***Not included for CGPA.**

III SEMESTER M.Sc. Electronics							
Subject Code	**Subjects**	**Hours/ Week**	**Duration of exams (Hrs)**	**Marks & Credits**			
				IA	**Exam**	**Total**	**Credits**
HARD CORE							
ELH 501	Digital Image Processing	4L	3	30	70	100	4
ELH 502	VLSI (Advanced)	3L	3	30	70	100	3
ELH 503	Embedded Processors	3L	3	30	70	100	3
SOFT CORE (Any Two can be opted)							
ELS 504	Data Science	3L	3	30	70	100	3

ELS 505	Deep Learning	3L	3	30	70	100	3
ELS 506	Cyber Security	3L	3	30	70	100	3
ELS 507	Nano Electronics	3L	3	30	70	100	3
PRACTICALS							
ELP 511	VLSI Lab	6H	3	30	70	100	3
ELP 512	Digital Image Processing Lab	6H	3	30	70	100	3
OPEN ELECTIVE							
ELE 509	Data Communication Technology	3L	3	30	70	100	3*
	Total	**29**	**21**	**210**	**490**	**700**	**22+3***

***Not included for CGPA.**

IV SEMESTER M.Sc. Electronics							
Subject Code	**Subject**	**Practical Hours/ Week**	**Marks & Credits**				
			IA	**Dissertation + Viva Exam**		**Total**	**Credits**
ELP 551	Project Work Report Viva-Voce	36	150	Report : 300 Viva-Voce: 50	350	500	18
Total Marks off I Semester						**700**	**23**
Total Marks off II Semester						**700**	**23+3***
Total Marks off III Semester						**700**	**22+3***
Total Marks of IV Semester						**500**	**18**
Grand Total Marks & Credits of all the Four Semesters						**2600**	**86+6***

***Not included for CGPA.**

Project Work at Electronics Industry / National Institute / University

Total Credit Distribution

Hard core Credits: 11 + 11 + 10 + 18 = 50 (54.4%)

Total Soft-Core Credits: 06 + 06 + 06 = 18 (19.6%)

Practical Credits: 06 + 06 + 06 = 18

(19.6%) Open Elective Credits: 03* + 03* = 06 (6.4%)

I SEMESTER

ELH 401 - DIGITAL SYSTEM DESIGN

Course Outcomes:

1. To understand number representation and conversion between different representation in digital electronic circuits.
2. To analyze logic processes and implement logical operations using combinational logic circuits.
3. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines.
4. To understand the concept of Programmable Devices, PLA, PAL, CPLD and FPGA and implement digital system using VHDL.

Unit –I

Introduction to Digital Design: Electronic Aspects of Digital Design, Integrated Circuits,Programmable Logic Devices, ASIC, PCB, Design Levels.
Digital Circuits: Logic Signals and Gates, Logic Families, CMOS Logic, Electrical Behavior ofCMOS Circuits – Steady State and Dynamic Behaviors.

16 Hours

Unit –II

Combinational Logic Design Principles: Switching Algebra, Combinational Circuit – Analysisand Synthesis, Minimization Methods, Timing Hazards.
Combinational Logic Design Practices: Combinational PLDs, Decoders, Encoders,Three-State Devices, Mux, Parity Circuits, Comparators.

16 Hours

Unit – III

Sequential Logic Design Principles: Bistable Elements, Latches and Flip-flops,SynchronousState Machine – Analysis and Design, Designing State Machines Using State Diagrams andTransition List, Counters, Shift Registers, Sequential Logic Design Practices.
Memory, CPLDs and FPGAs: ROM, RAM – Static RAM, Dynamic RAM. Architecture ofCPLD and FPGA family.

16 Hours

Text Books:

1. "Digital Design – Principles and Practices", John F. Wakerly, Pearson Education Asia,Fourth Edition, 2008
2. "Digital Design with Introduction to Verilog HDL‖, Mano M M and Michael Ciletti,Pearson Education Asia, 5thEdn.2013
3. Digital Fundamentals‖, Floyd T L, Pearson Education Asia, 8th Edn.2002.

ELH 402 - MICROCONTROLLERS AND PIC

Unit I

Course Outcomes:

1. Describe the Microcontroller and applications.
2. Details architecture of the 8051 microcontroller and PIC 18 microcontroller.
3. Makes students aware of interrupts and describing about I/O ports to handle external signal
4. Handling Display system, DAC and ADC to performing interface, with real world application devices.
5. Ability to describe application based projects.

Introduction to Microcontrollers: Microcontroller Data Types, Evolution of the Microcontroller,
Microcontroller Basics: Basic Blocks of a Microcomputer, Microcontroller Architectures, Central Processing Unit (CPU), Basic Concept of Pipelining, RISC vs. CISC,
Introduction to Programming Languages: Basics of Programming Languages, Machine Language, Assembly Language, High-Level Language, Choosing a Programming Language
Microcontroller Memory and Input/Output (I/O): Introduction to Microcontroller Memory, Microcontroller Input/Output (I/O)

16 Hours

Unit II

8051 Microcontroller - Architecture, Data type and Directives, Flags and PSW, Register Banksand Stack, Addressing Modes, I/O Ports. Instruction set – Data transfer instruction, Arithmeticnd logical instructions. Jump, Loop and Call Instructions and Programming.

16 Hours

Unit III

PIC18F ARCHITECTURE AND ADDRESSING MODES: PIC18F Register Architecture, PIC18F Memory Organization, PIC18F Addressing Modes.

PIC18F HARDWARE AND INTERFACING: PIC18F Pins and Signals, PIC18F4321 I/O Ports, PIC18F Interrupts, PIC18F Timers, Analog Interface, Serial Interface, PIC18F4321 Capture/Compare/PWM (CCP) Modules

16 Hours

Books:

1. “Microcontroller Theory and Applications with the PIC18F”,M. Rafiquzzaman, Wiley, 2011.
2. “The 8051 Microcontroller Architecture, Programming and Applications”,K. J. Ayala,Penram Int. Pub., 1991
3. ”Pic Microcontroller and Embedded Systems: Using Assembly And C For Pic 18”, Muhammad Ali Mazidi, Pearson Education
4. “Designing Embedded Systems using PIC microcontrollers Principlesand Applications.”, Tim Wilmshurst, Second Edition, Elesevier, 2010
5. “Microcontrollers: Theory and Applications”,Ajay V deshmukh, Tata McGraw-HillEducation.

ELH 403 - BASIC VLSI DESIGN

Course Outcomes:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Concepts of modeling a digital system using Hardware Description Language.

UNIT I

Introduction to CMOS Design: The CMOS IC Design Process, CMOS Background, AnIntroduction to SPICE. The Well: Patterning, Laying Out the N-well, Resistance Calculation, The N-well/Substrate Diode, The RC Delay through the N-well, Twin Well Processes.

The Metal Layers: The Bonding Pad, Design and Layout Using the Metal Layers, Crosstalk and Ground Bounce, Layout Examples. The Active and Poly Layers : Layout Using the Active and Poly Layers, Connecting Wires to Poly and Active, Electrostatic Discharge (ESD) Protection

12 Hours

UNIT II

MOSFET Operation: MOSFET Capacitance Overview/Review, The Threshold Voltage, IVCharacteristics of MOSFETs, SPICE Modeling of the MOSFET. Models for Digital Design: TheDigital MOSFET Model, The MOSFET Pass Gate.

The Inverter : DC Characteristics, SwitchingCharacteristics, Layout of the Inverter, Sizing for Large Capacitive Loads, Other InverterConfigurations.

12 Hours

UNIT III

Static Logic Gates : DC Characteristics of the NAND and NOR Gates, Layout of the NAND andNOR Gates, Switching Characteristics, Complex CMOS Logic Gates. Clocked Circuits: TheCMOS TG, Applications of the Transmission Gate, Latches and Flip-Flops.

12 Hours

Books :

1. “CMOS: Circuit Design, Layout, and Simulation,” 3rd Ed, R. Jacob Baker, IEEE Press Series on Microelectronic Systems.
2. “Basic VLSI Design,” Douglas A. Pucknell& Kamran Eshraghian, PHI 3rd Edition, 2005.
3. “CMOS VLSI Design: A Circuits and Systems Perspective‖,” Fourth Edition, Neil H. E.Weste, David Money Harris

ELS 404 - VERILOG HDL

Course Outcomes:

1. Familiarize with the CAD tool to write HDL programs.
2. Design, simulate and synthesize digital logic circuits using Verilog HDL
3. Design sequential and combinational logic circuits for real-time applications.
4. Exposure to hardware-software co-design
5. Interface hardware to programmable logical devices like CPLDs/FPGAs/Microcontroller.

UNIT – I

Introduction: Overview of Digital Design with Verilog HDL Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL?Trends in HDLs.
Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block
Basic Concepts: Lexical conventions, data types, system tasks, compiler directives. Modules and Ports Module definition, port declaration, connecting ports, hierarchical name referencing.

12 Hours

UNIT – II

Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delay, Strengths and Construction Resolution, Net Types, Design of Basic Circuit.
Behavioral Modeling: Introduction, Operations and Assignments ,Functional Bifurcation, 'Initial' Construct, Assignments with Delays, 'Wait' Construct, Multiple Always Block, Designs at Behavioral Level, Blocking and Non-Blocking Assignments, The 'Case' Statement, Simulation Flow, 'If' an 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, Parallel Blocks, Force-Release, Construct, Event.

12 Hours

UNIT – III

Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators.
Sequential Circuit Description: Sequential Models - Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis.
Components Test and Verification: Test Bench - Combinational Circuits Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

12 Hours

Text Books:

1. Samir Palnitkar, ―Verilog HDL: A Guide to Digital Design and Synthesis‖, Pearson
1. Education, Second Edition.
2. Digital Design (Verilog) An Embedded Systems Approach Using Verilog, Peter
3. Ashenden, Elsevier Publications, 1st Edition 2008
4. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI,2009.
5. T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009

ELS 405 - POWER ELECTRONICS

Course Outcomes:

1. The study will have in-depth understanding of the theory of electrical energy conversion using power electronic systems that perform AC/DC, DC/DC or DC/AC conversion.
2. Develop skill to understand the operating principles and modulation strategies for single phase and three phase diode rectifiers, thyristor-based converters, as well as, switch- modeDC/DC power electronic converters and DC/AC inverters.
3. Develop skills to understand the advanced modeling and control of power electronic converters.
4. Makes being able to identify the most important design parameters and to recognize the impact of operating parameters on the planning and use of power electronic converters in the existing and future electric power grid infrastructure, and in industrial installations.

UNIT I

Introduction; Power Electronics Defined, Key Characteristics, Trends in Power Supplies,Conversion Examples, Tools for Analysis and Design, Sample Applications.
Power semiconductor devices: The Power Diode, Power Bipolar Transistors, The Power MOSFET, Insulated Gate Bipolar Transistor- Turn-on and turn-off characteristics.

12 HOURS

UNIT II

The Thyristors, Gate Turn-off Thyristors, MOS Controlled Thyristors, Static Induction DevicesTurn-on and turn-off characteristics.
Power Conversion; Diode Rectifiers-Single-phase Diode Rectifiers, Three-phase Dioderectifiers.
Single-phase Controlled Rectifiers; Introduction, Line-commutated Single-phase ControlledRectifiers.

12 HOURS

UNIT III

DC–DC Converters; Introduction, DC Choppers, Step-down (Buck) Converter, Step-up (Boost)Converter, Buck–Boost Converter, Cuk Converter, Effects of Parasitics, Synchronous andBidirectional Converters, Control Principles, Applications of DC–DC Converters.
Inverters; Introduction, Single-phase Voltage Source Inverters, Three-phase Voltage SourceInverters, Current Source Inverters.
AC–AC Converters; Introduction, Single-Phase AC–AC Voltage Controller, Three-Phase AC–AC Voltage Controllers, Applications of AC–AC Converters.

12 HOURS

Books:

1.“Power Electronics: Circuits, Devices and Applications”, M.H. Rashid, Pearson Education,PHI Third edition, New Delhi 2004.
2. “Elements of Power Electronics”, Philip T. Krein, Oxford University Press, 2004 Edition.
3. “Power Electronics for Technology Pearson Education”, Ashfaq Ahmed, Indian reprint,2003.
4. “Power Electronics”Khanna Publishers, third Edition 2003.
6. “Power Electronics: Converters, Applications and Design”, Ned Mohan, Tore. M. Undeland, William. P. Robbins, John Wiley and sons, third edition, 2003

ELS 406 – COMPUTER ARCHITECTURE

COURSE OBJECTIVES:

1. To impart basic concepts of computer architecture and organization,
2. To explain key skills of constructing cost-effective computer systems.
3. To familiarize the basic CPU organization.
4. To help students in understanding various memory devices.
5. To facilitate students in learning I/O communication

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Identify various components of computer and their interconnection
2. Identify basic components and design of the CPU: the ALU and control unit.
3. Compare and select various Memory devices as per requirement.
4. Compare various types of I/O mapping techniques
5. Critique the performance issues of cache memory and virtual memory

UNIT - I

STRUCTURE OF COMPUTERS: Computer types, Functional units, Basic operational concepts, VonNeumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.

BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit

12 Hours

UNIT – II

Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC

REGISTER TRANSFER AND MICRO-OPERATIONS: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. MICRO-PROGRAMMED CONTROL: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

12 Hours

UNIT - III

MEMORY SYSTEM: Memory Hierarchy, Semiconductor Memories, RAM(Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.

INPUT OUTPUT: I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA. MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence

12 Hours

Books:

1. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.
2. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
3. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
4. Andrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,
5. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGraw Hill

ELS 407 - Python Programming

Course outcome

1. Demonstrate proficiency in handling loops and creation of functions.
2. Identify the methods to create and manipulate lists, tuples and dictionaries.
3. Develop programs for string processing and file organization
4. CO4 Interpret the concepts of Object-Oriented Programming as used in Python.

Unit – I

Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program,
Flow control: Boolean Values, Comparison Operators, Boolean Operators,Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules,Ending a Program Early with sys.exit(), **Functions:** def Statements with Parameters, Return Values and return Statements,The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number**Lists:** The List Data Type, Working with Lists, Augmented Assignment Operators, Methods,Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References,

12 Hours

Unit – II

Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using DataStructures to Model Real-World Things,
Manipulating Strings: Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup
Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module,Saving Variables with the print.format() Function, Project: Generating Random Quiz Files, Project: Multiclipboard,
Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates,Project: Backing Up a Folder into a ZIP File

12 Hours

Unit – III

Debugging: Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE‟s Debugger.
Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying,
Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, **Classes and methods:** Object-oriented features, Printing objects, Another example, A more complicated example,Theinit method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation.

12 Hours

Text Books:

1. Al Sweigart,**“Automate the Boring Stuff with Python”,**1stEdition, No Starch Press, 2015.
2. Allen B. Downey, **“Think Python: How to Think Like a Computer Scientist”,** 2nd Edition, Green Tea Press, 2015

II SEMESTER

ELH 451 - DIGITAL SIGNAL PROCESSING

Course Outcomes:

1. Understand the frequency domain analysis and synthesis of discrete time signal
2. Sampling and reconstruction of discrete time signals.
3. Understand the basics computation theory through DFT based algorithms
4. Realization of FIR and IIR filters in different structural forms.
5. Designing procedure to convert analog filters to digital (IIR) filters using BLT and other methods
6. Study on different windows to design FIR filters

Unit I

Introduction: Introduction to Digital Signal and Digital Signal Processing, advantages and limitations of digital signal processing,Basic parts of analog to digital converter (Sampling and quantization), Elementary discrete time signals, Classification of discrete time signals, Basic operations of discrete time signals, Classification of discrete time systems,

The Convolution Sum, Properties, Stable LTI system, Causal LTI system, Linearconstant coefficient differenceequations.

Z- Transforms: Direct and Inverse Transform, Properties of Z-Transform (Linear, Time –shift and convolution), Rational Z-Transforms, Inversion of the Z-transform (Partial fraction method), Analysis of LTI system in Z-domain.

16 hours

Unit II

Sampling: Ideal sampling and reconstruction of continuous time signals, Sampling theorem, Aliasing. Introduction to Fourier analysis of signals.

Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction ofdiscrete time signals. DFT as a linear transformation, its relationship with other transforms.Properties of DFT.

FFT Algorithms: Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-intimeand decimation-in-frequency algorithms.

16 hours

Unit III

Structure for IIR Systems: Direct form, Cascade form, Parallel form structures.
IIR filterdesign: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters,analog to analog frequency transformations.

Structure for FIR Systems: Direct form, Linear Phase, Frequency sampling structure, Latticestructure.
FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular,Hamming, Hanning and Bartlett windows

16 hours

Books:

1. “Digital signal processing” Principles Algorithms & Applications, Proakis&Monalakis,Pearson education, 4th Edition, New Delhi, 2007.
2. “DSP Processor Fundamentals: Architectures and Features”, P. Lapsley, J. Bier, A, Shohamand E. Lee, John Wiley & Sons, ISBN 0-7803-3405-1. 1996.
3. “Discrete Time Signal Processing”, Oppenheim & Schaffer, PHI, 2003.
4. “Digital Signal Processing”, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010.

ELH 452 – DIGITAL AND WIRELESS COMMUNICATION

Course objectives: This course will enable students to:

1. Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
2. Understand the concepts of propagation over wireless channels from a physics standpoint
3. Understand the multiple access techniques used in cellular communications standards
4. Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony

Course outcomes (Course Skill Set): At the end of the course the student will be able to:

1. Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.
2. Understand the essential concepts and principles of mobile radio channel and cellular communication.
3. Describe various multiple access techniques used in wireless communication systems.
4. Describe the GSM architecture and procedures to establish call set up, call progress handling and call tear down in a GSM cellular network.

Unit-I

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver.

16 Hours

Unit-II

Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel. Principles of Cellular Communications: Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality

Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes.

16 Hours

Unit-III

A Basic Cellular System: A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system.

Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features.

16 Hours

Books:

1. Simon Haykin, “Digital Communication Systems”, John Wiley & sons, First Edition, 2014, ISBN 978-0- 471-64735-5

2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0- 07-068178-3.
3. John G Proakis and Masoud Salehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
4. Bernard Sklar, “Digital Communications – Fundamentals and Applications”, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
5. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
6. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

ELH 453 – AI and MACHINE LEARNING

Course Outcomes:

1. Comprehend concepts in the field of Artificial Intelligence
2. Apply the knowledge of mathematics and programming to structure datasets and algorithms to build machine learning models.
3. Analyze the neural networks and CNN architectures in application to different use cases and performance measures to evaluate the models.
4. Design and develop reinforcement agents using Q Learning
5. Engage on survey of various available datasets and possible sustainable solutions that could be developed for the societal need.

Unit-I

Introduction to Artificial Intelligence& Data Analysis: Basic concepts of Artificial Intelligence, Necessity of learning AI, Applications of AI, Cognitive modelling, Introduction to Machine learning and Deep learning, Essentials of Linear Algebra and Applied Statistics, Introduction to Python Libraries: Scikit Learn, NumPy, Pandas, Matplotlib, Seaborn, Exploratory data analysis, Key Performance Indicators.

Machine Learning: Supervised learning: Linear methods for regression and classification, Non-linear regression, regularization, decision trees, ensemble methods, modelling & cross validation. Unsupervised learning: k-means clustering, Hierarchical clustering, DBSCAN clustering, Applications: bio-informatics, commercial data mining.

12 Hours

Unit-II

Artificial Neural Networks and Learning Principles: Biological Neuron, Perceptron, MLP model, Feed-Forward and Backpropagation, learning with SGD, Activation Functions, Loss Functions, Various optimizers and applicability, Hyper parameters: Learning Rate, regularization, Momentum, Sparsity; Fully Connected Neural Network, Model Training& Evaluation. Applications: Anomaly detection dealing with high dimensional CSV dataset.

Convolutional and Recurrent Neural networks: Convolutional Neural Network, Architecture Overview: Convolutional and Pooling Layers.

12 Hours

Unit-III

Applications of CNN, Variants of CNN Architecture, Model building using CNN on complex image dataset. Recurrent Neural Network Architecture, LSTM Networks, Building Blocks: Restricted Boltzmann Machine (RBM), Auto-encoders, Variational Auto-encoders. Applications: Image recognition, Speech recognition, text recognition and web data retrieval,

Reinforcement Learning: Introduction to RL, Terms and Key features in RL, Approaches to implement RL, BellmanEquation, RL Algorithm, Markov Decision Process, Q-learning, and Applications of RL.

12 Hours

Text books:

1. "Machine Learning"SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson
2. "Introduction to Machine Learning with Python: A Guide for Data Scientists",Andreas C. Muller and Sarah Guido, O'Reilly Publication, 2019.

3. “Machine Learning in Action”, Peter Harrington, Dreamtech Press Indian Edition, 2017
4. “Deep Learning- A Practitioner’s Approach”, Josh Patterson & Adam Gibson,O’Reilly Publication, 2019
5. “Deep Learning with Python” Francois Chollet , Manning Publications, 1st edt.
6. “Handbook of Reinforcement Learning and control”, Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, DeryaCanseve, Springer- 2021

ELS – 454 EMBEDDED SYSTEM DESIGN

Course Outcome:

1. Explain characteristics of Embedded System design
2. Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS
3. Analyze embedded system software and hardware requirements
4. Develop programming skills in embedded systems for various applications.
5. Design basic embedded system for real time applications

Unit – I

Introduction: Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems.

Core of Embedded Systems: Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components

12 Hours

Unit – II

Characteristics and quality attributes of embedded systems: Characteristics, Operational and non-operational quality attributes, application specific embedded system – washing machine, domain specific – automotive.

Hardware Software Co design and Program Modelling: Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design. Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools

12 Hours

Unit – III

Embedded Firmware Design and Development: Embedded Firmware DesignApproaches,Embedded Firmware Development Languages.

Embedded System Development Environments: Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/de-compiler, Simulators, Emulators and Debugging.

Real-time Operating System(RTOS) based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

12 Hours

Text Book:

1. Shibu K V, "Introduction to Embedded Systems", Second Edition, McGraw Hill.
2. Raj Kamal, "Embedded system architecture, Programming and design‖", 2nd End, Tata Mc'Graw Hill.
3. Tammy Noergaard, " Embedded Systems Architecture A Comprehensive Guide for Engineers and Programmers‖", Elsevier, 2005
4. Jorgen Staunstrup and Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice‖", Springer-Science+Business Media.

ELS 455 - Microwave Devices

Course Outcomes:

1. Study on high frequency microwave devices for satellite and RADAR communication.
2. Describe the working and construction of metal oxide, metal semiconductor and transferred electron devices.
3. Study the fundamentals of working and construction of RADAR system.
4. Study the block diagram, basic laws and working principles of satellite communication

Unit I

Microwave devices: Klystron, Velocity Modulation, Bunching process reflex Klystron efficiency, magnetron and traveling wave tubes: Principle of operation of Magnetron, Microwave characteristics, Helix TWT‟s, amplification process, microwave transistor, MESFETs, Transferred Electron Devices, Gunn effect, principle of operations, mode of operation , IMPATT, TRAPATT diodes.

12 Hours

Unit II

RADAR: Introduction, Radar block diagram and operation, RADAR equation, factor affecting range of RADAR, maximum unambiguous range, Pulse RADAR System, RADAR display, scanning and tracking with radar, Doppler effect, CW Doppler radar, MTI, Frequency Modulated CW RADAR and RADAR antennas.

12 Hours

Unit III

Satellite Communication: Introduction, Kepler‘s law, Orbits geostationary orbits, power systems, attitude Control, TT&C. Transponders, antenna subsystems, station keeping, uplink and downlink budget calculations.

12 Hours

Books:

1. S Y Liao: Microwave devices and circuits, PHI 1980
2. M I Skolik: Introduction to radar system, 2/c McGraw Hill, 1990
3. A K Sen and A B Bhattacharya, Radar Systems and radio aids to navigation 2/c Khanna Publications, New Delhi 1992.
4. Roddy and Coolen: Electronic Communications, 4/c, PHI, 1995.
5. B C Agrawal: satellite Communication, Khanna Publications
6. A S Tabebbaym: Computer Network, 3/c, PHI, 1999
7. M Kulakarni: Microwave and radar engineering, Umesh publications.

ELS 456 - LOW POWER VLSI

Course Outcomes:

1. Understand why low power design is important and learn different ways to reduce power in electronic circuits.
2. Learn how MOS transistors are made and understand problems like latch-up and short-channel effects.
3. Know how MOS transistors and inverters work and how they are used in circuits.
4. Design simple MOS logic circuits and learn how power is used and saved in these circuits.
5. Use methods to reduce leakage power and design circuits that work better with batteries.

Unit-I

Introduction, Historical Background, Why Low Power?, Sources of Power Dissipations, Low-Power Design Methodologies.
MOS Fabrication Technology: Introduction, Basic Fabrication Processes, nMOS Fabrication Steps, CMOS Fabrication Steps, Latch-Up Problem and Its Prevention, Short-Channel Effects.
MOS Transistors: Introduction, the Structure of MOS Transistors, the Fluid Model, Modes of Operation of MOS Transistors, Electrical Characteristics of MOS Transistors, MOS Transistors as a Switch.
MOS Inverters: Introduction, Inverter and Its Characteristics, MOS Inverter Configurations, Switching Characteristics, Delay Parameters, Driving Large Capacitive Loads.

12 Hours

Unit-II

MOS Combinational Circuits: Introduction, Pass-Transistor Logic, Gate Logic, MOS Dynamic Circuits.
Sources of Power Dissipation: Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Glitching Power Dissipation, Leakage Power Dissipation.
Supply Voltage Scaling for Low Power: Introduction, Device Feature Size Scaling, Architectural-Level Approaches, Multilevel Voltage Scaling, Challenges in MVS, Dynamic Voltage and Frequency Scaling, Subthreshold Logic Circuits.

12 Hours

Unit-III

Leakage Power Minimization; Introduction, Fabrication of Multiple Threshold Voltages, VTCMOS Approach, Transistor Stacking, MTCMOS Approach, Power Gating, Isolation Strategy, Power Management.
Battery-Aware Systems: Introduction, the Widening Battery Gap, Overview of Battery Technologies, Battery Characteristics, Principles of Battery Discharge, Battery Modeling.

12 Hours

Book:

1. Low-Power VLSI circuits and Systems" AjithPal,Springer Publication, 2015, ISBN 978-81-322-1936-1.
2. "Practical Low Power Digital VLSI design", Gary Yeap (Motorola), Springer Science + Business Media, LLC, 1998
3. "CMOS Low Power Digital Design," A. Chandrakasan& R. Brodersen, Kluwer Academic Pubs. 1995.
4. "Low Power Design Methodologies,"J. Rabaey& M. Pedram (Editors), Kluwer AcademicPubs. 1996.
5. "Low Power Digital VLSI Design Circuits and Systems", AbdellatifBellaouar, MohamedI. Elmasry, S. Ramamurthy, Springer Science+Business Media, LLC, 1995

ELS - 457 Internet of Things

Course objectives

1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
2. Understand the recent application domains of IoT in everyday life.
3. Gain insights about the current trends of Associated IOT technologoes and IOT Anlaytics.

Course outcome:

1. Describe the evolution of IoT, IoT networking components, and addressing strategies in IoT.
2. Classify various sensing devices and actuator types.
3. Demonstrate the processing in IoT.
4. Explain Associated IOT Technologoes
5. Illustrate architecture of IOT Applications

Unit-I

Basics of Networking: Introduction, Network Types, Layered network models
Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence ofTechnologies, IoT Networking Components.
IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, SensingTypes, Sensing Considerations, Actuators, Actuator Types, actuator Characteristics.

12 Hours

Unit-II

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies,IoT Device Design and Selection Considerations, Processing Offloading.
Associated Iot Technologies: Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing,Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.

12 Hours

Unit-III

Iot Case Studies: Agricultural IoT - Introduction and Case Studies,
Iot Case Studies And Future Trends: Vehicular IoT – Introduction, Healthcare IoT - Introduction, IoT Analytics - Introduction and Case Studies

12 Hours

Text Books:

1. SudipMisra, Anandarup Mukherjee, Arijit Roy, “Introduction to IoT”, Cambridge University Press 2021.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
3. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014.
4. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

ELE 459 - Introduction to Artificial Intelligence

Course Outcomes:

1. Comprehend concepts in the field of Artificial Intelligence
2. Apply the knowledge of mathematics and programming to structure datasets and algorithms to build machine learning models.
3. Analyze the neural networks and CNN architectures in application to different use cases and performance measures to evaluate the models.
4. Design and develop reinforcement agents using Q Learning
5. Engage on survey of various available datasets and possible sustainable solutions that could be developed for the societal need.

Unit I

Introducing AI, Defining the Role of Data, Considering the Use of Algorithms: Pioneering Specialized Hardware: Using GPUs, Working with Deep Learning Processors (DLPs) AI Uses in Computer Applications, Automating Common Processes, Using AI to Address Medical Needs, Relying on AI to Improve Human Interaction

12 Hours

Unit II

Performing Data Analysis for AI, Employing Machine Learning in AI, Improving AI with Deep Learning, Working with AI in Hardware Applications, Developing Robots

12 Hours

Unit III

Drones, AI-Driven Car, Considering the Future of AI, Understanding the Nonstarter Application, Seeing AI in Space, Engaging in Human Endeavors, Ten Substantial Contributions of AI to Society

12 Hours

Books:

1. John Paul Mueller and Luca Massaron, “Artificial Intelligence For Dummies”, Published by: John Wiley & Sons, 2nd Edition ,2022
2. Shireeshkumar Sharadkumar Rudrawar, “AI for Everyone: Fundamentals ” ISBN: 978-81-957387-3-1, 2023
3. Francois Chollet “Deep Learning with Python”, Manning Publications, 1st edt.
4. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, DeryaCanseve , “Handbook of Reinforcement Learning and control”, Springer- 2021
5. Stuart J. Russell and Peter Norvig “Artificial Intelligence A Modern Approach” Third Edition, Pearson Education, 2010

III SEMESTER

ELH 501 - DIGITAL IMAGE PROCESSING

Course Outcomes:

1. Fundamentals of digital image acquisition and processing to compare with human visual system.
2. Study on image as spatial domain as well as frequency domain signal using transformation functions.
3. Application of 2-D DFT for image enhancement and demising process.
4. Study on mathematical modeling of noise functions and corresponding filter design
5. Study on the Morphological Operations and Segmentation used in digital image processing. Basics of color image processing and various color models for image representation

Unit I

Introduction and Digital Image fundamentals: Introduction to Digital Image Processing, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Mathematical tools used in DIP.
Intensity Transformations and Spatial Filtering: Some basic intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Unit II

Filtering in Frequency Domain: Preliminary concepts, Sampling, Fourier Transform of sampled Functions, DFT of two variables, Properties of 2D DFT, Basics of Filtering in the Frequency Domain, Image Smoothing using Frequency-Domain Filters, Image Sharpening using Frequency Domain Filters, Selective Filtering.
Image Restoration and Reconstruction: Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant.

Unit III

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit or Miss Transformation, Basic Morphological Algorithms, Gray Scale Morphology.
Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo color Image Processing, Full-Color Image Processing, ColorTransformations, Smoothing and Sharpening.

Text Books:

1. Digital Image Processing‖, Rafael Gonzalez and Richard Woods, PHI.2nd Edition.
2. Fundamentals of Digital Image Processing‖, A. K. Jain, Prentice Hall of India, 1989.
3. Digital Image Processing‖, W. K. Pratt, Prentice Hall, 1989.

ELH 502 -VLSI (Advanced)

Course Outcomes:

1. Analyze and design advanced combinational and sequential logic using CMOS circuit families and timing strategies.
2. Design high-speed arithmetic and memory subsystems, and apply power, clock, and I/O integration techniques.
3. Apply structured design methodologies and implement effective test strategies in digital VLSI and SoC systems.
4. Interpret design challenges and foundational principles in emerging domains such as RF, DSP, mixed-signal, and SoC VLSI.

Unit I

Combinational Logic Design

Overview of CMOS logic families: Static, dynamic, ratioed, pass-transistor, Pitfalls: Threshold drops, charge sharing, noise, leakage, Subthreshold and SOI logic concepts **Sequential Logic Design**

Timing and synchronization: Setup/hold time, skew, time borrowing, Latch and flip-flop design: Static, dynamic, pulsed, SDFF, TSPC, Synchronizers and metastability Clocking issues in high-speed design

12 Hours

Unit II

Datapath and Memory Subsystems

High-speed adder structures, shifters, multipliers, Comparator and counter circuits, SRAM, DRAM, ROM, Flash basics; memory design issues (area, power, speed)

Special-Purpose and Peripheral Subsystems

Clock generation and distribution (PLL, DLL, gating, skew control), Power distribution: On-chip IR drop, bypass caps, Basic I/O design and high-speed link considerations

12 Hours

Unit III

Design Methodology and Testing

Structured design: Hierarchy, modularity, SoC flows, Basic ASIC design flows and custom layout, Logic verification, ATPG, scan design, BIST, DFT principles

Emerging topics in VLSI

Components of SoC, Design flow of SoC, Hardware/Software nature of SoC, Design Trade-offs, SoC Applications.

Basic concepts in RF & Wireless Integrated Circuits Design, Basic concepts in DSP VLSI, Basic concepts in mixed signal design

12 Hours

Books:

1. Neil H.E. Weste, David Harris, and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective” , Addison Wesley/ Pearson education 4th edition, 2019

2. Michael J.Flynn, Wayne Luk, —Computer system Design: Systemon-Chip‖, Wiley-India, 2012.
3. Sudeep Pasricha, Nikil Dutt, —On Chip Communication Architectures: System on Chip Interconnect‖, Morgan Kaufmann Publishers, 2008
4. Thomas H Lee, —The design of CMOS Radio Frequency Integrate Circuits‖, 2nd Edition, Cambridge University Press, 2003.
5. 2. R. Jacaob Baker, —CMOS- Mixed Signal Circuit Design‖, 2 nd Edition, Wiley-IEEE Press, 2009.

ELH 503 - Embedded Processors

Course Outcomes

1. Analyze the architectures of different Embedded Processors
2. Identify an appropriate on chip peripherals for serial and parallel communication
3. Examine the functions of ARM processors
4. Develop real time applications using ARM processors
5. Develop a firmware for embedded applications
6. Develop innovative products using Embedded processors

Unit I

Introduction To Embedded Processors

Introduction to embedded processors– Compare Von Neumann architecture and Harvard architecture, RISC Vs CISC – System on Chip (SoC)-Introduction to SoC Architecture, An approach for SOC Design, System Architecture and Complexity. Processor Selection for SOC, Basic concepts in Processor Architecture, Overview of SOC external memory, Internal Memory, Scratchpads and Cache memory, SOC Memory System, Models of Simple Processor – memory interaction, SOC Standard Buses

Embedded Processors On Chip Peripherals

Memory - Interrupts - I/O Ports-Timers & Real Time Clock (RTC), Watch dog timer -CCP modules - Capture Mode - Compare Mode-PWM Mode - Serial communication module - USART - SPI interface - I2C interface, Analog Comparator, Analog interfacing and data acquisition.

12 Hours

Unit II

Arm Processor

Architecture of ARM Controller – Registers, Pipeline organization 3 stage & 5 stage, Thumb mode of operation - D/A and A/D converter, sensors, actuators and their interfacing – Case study- Digital clock, Temperature sensing, Light sensing, Introduction to Internet of Things, smart home concepts

Real World Interfacing Using Arm Processor

Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SD card interface using SPI, on-chip DAC for waveform generation.

12 Hours

Unit III

Arm Cortex Processors

Introduction to ARM CORTEX series, improvement over classical series and advantages for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, need of operating system in developing complex applications in embedded system, Firmware development for ARM Cortex, Survey of CORTEX M3 based controllers, its features and comparison

12 Hours

Books:

1. F. Vahid and T. Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India Pvt. Ltd., 2002.
2. Michael J. Flynn and Wayne Luk, “Computer System Design System-on-Chip”, Wiley India Pvt. Ltd.
3. Steve Furber, “ARM System on Chip Architecture “, 2nd Edition, 2000, Addison Wesley Professional.
4. S. Pascricha and N. Dutt, Morgan Kaufmann, On-Chip Communication Architectures, System on Chip Interconnect, -Elsevier Publishers 2008
5. Mark Fisher, “ARM Cortex M4 Cookbook”, Packt Publishing, 2016.
6. Lyla B. Das, “Architecture, Programming and Interfacing of Low-power Processors ARM 7, Cortex-M”, Cengage, 1st Edition, 2017.
7. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, Newness, 2nd Edition, 2009

ELS 504 - Data Science

Course Outcomes:

1. Identify and list various Big Data concepts, tools and applications.
2. Develop programs using HADOOP framework.
3. Use Hadoop Cluster to deploy Map Reduce jobs, PIG,HIVE and Spark programs.
4. Analyze the given data set and identify deep insights from the data set.

Unit I

What is data science? Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data,Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment.

Big Data Analytics: What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools, NoSQL, Hadoop.

12 Hours

Unit II

Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator).

Introduction to Map Reduce Programming: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.

12 Hours

Unit III

Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF).

Introduction to Pig: What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.

Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark.

12 Hours

Books:

1. Seema Acharya and Subhashini Chellappan “Big data and Analytics” Wiley India Publishers, 2nd Edition, 2019.
2. Rajkamal and Preeti Saxena, “Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning”, McGraw Hill Publication, 2019.
3. Adam Shook and Donald Mine, “Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems” - O'Reilly 2012

4. Tom White, “Hadoop: The Definitive Guide” 4th Edition, O’reilly Media, 2015.
5. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016
6. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition

ELS 505 - Deep Learning

Course Outcomes:

1. Understand the differences between shallow and deep learning, and the challenges in neural network optimization.
2. Explain the architecture and training methods of Convolutional Neural Networks (CNNs) and key models like LeNet-5 and AlexNet.
3. Describe the concepts and structures of Recurrent Neural Networks (RNNs), including LSTM and GRU.
4. Demonstrate a basic understanding of reinforcement learning and its integration with deep learning models.

Unit I

Introduction to Deep Learning Introduction, Shallow Learning, Deep Learning, Why to use Deep Learning, How Deep Learning Works, Deep Learning Challenges,. How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization.

12 Hours

Unit II

Basics of Supervised Deep Learning Introduction, Convolution Neural Network, Evolution of Convolution Neural Network, Architecture of CNN, Convolution Operation

Training Supervised Deep Learning Networks Training Convolution Neural Networks, Gradient Descent-Based Optimization Techniques, Challenges in Training Deep Networks. Supervised Deep Learning Architectures: LeNet-5,AlexNet

12 Hours

Unit III

Recurrent and Recursive Neural Networks Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory. Gated RNNs.
The Basic Framework of Reinforcement Learning

12 Hours

Books:

1. M. Arif Wani Farooq Ahmad Bhat Saduf Afzal Asif Iqbal Khan, Advances in Deep Learning, Springer, 2020
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning”, Springer, 2018.
4. N.D. Lewis, “Deep Learning Made Easy with R: A Gentle Introduction for Data Science”, January 2016
5. Nikhil Buduma, “Fundamentals of Deep Learning: : Designing Next-Generation Machine Intelligence Algorithms”, O’Reilly publications
6. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009

ELS 506 – Cyber Security

Course Outcomes:

1. Understand the fundamentals of information security, threat vectors, types of attacks, and risk analysis techniques.
2. Analyze and interpret compliance frameworks and standards such as COBIT, ISO 27000, NIST, and relevant laws and regulations.
3. Apply secure design principles including the CIA triad, defense models, and zones of trust in security planning.
4. Describe and differentiate authentication and authorization methods including password-based, certificate-based, and biometric approaches.
5. Design secure network architectures using concepts such as DMZs, intranets, and firewalls, while considering cost, performance, and availability.
6. Evaluate the security of network devices, implement hardening techniques, and mitigate vulnerabilities in wired and wireless networks.

Unit I

Information Security Overview : The Importance of Information Protection, The Evolution of Information Security, Justifying Security Investment How to Build a Security Program : The Weakest Link, Strategy and Tactics, Business Processes vs. Technical Controls

Risk Analysis : Threat Definition : Threat Vectors, Threat Sources and Targets, Types of Attacks : Malicious Mobile Code, Advanced Persistent Threats (APTs), Manual Attacks, Risk Analysis,

Compliance with Standards: COBIT, ISO 27000 Series, NIST, Regulations Affecting Information Security Professionals, Laws Affecting Information Security Professionals

12 Hours

Unit II

Secure Design Principles: The CIA Triad and Other Models, Defence Models, Zones of Trust, Best Practices for Network Defence,

Security Policies, Standards, Procedures, and Roles and Responsibilities and Guidelines

Security organization: Roles and Responsibilities, Managed Security Services, Security Council, Steering Committee, or Board of Directors, Interaction with Human Resources

Authentication and Authorization: Authentication, Usernames and Passwords, Certificate-Based Authentication, Extensible Authentication Protocol (EAP), Biometrics, Additional Uses for Authentication, Authorization, User Rights, Role-Based Authorization (RBAC) , Access Control Lists (ACLs), Rule-Based Authorization

12 Hours

Unit III

Introduction to Secure Network Design: Acceptable Risk, Designing Security into a Network, Designing an Appropriate Network, The Cost of Security, Performance, Availability, Intranets, Extranets, and DMZs, Outbound Filtering

Network Device Security : Switch and Router Basics: MAC Addresses, IP Addresses, and ARP, TCP/IP, Hubs, Switches, Routers, Network Hardening: Patching, Switch Security Practices
Firewalls: Overview: The Evolution of Firewalls, Application Control, Must have Firewall features, Firewall Strengths and Weaknesses, Firewall Placement, Firewall Configuration, Virtual Private Networks: How a VPN Works, VPN Protocols
Wireless Vulnerabilities and Mitigations, AI in cyber security.

12 Hours

Books:

1. Mark Rhodes-Ousley, Roberta Bragg, Keith Strassberg “Information Security - The Complete Reference McGraw Hill Education; Second Edition
2. Anne Kohnke, Dan Shoemaker, Ken Sigleer “The Complete Guide to Cybersecurity Risks and Controls” Internal Audit and IT Audit Series, CRC Press Taylor &Francis Group, 2016
3. Chey Cobb “Network Security For Dummies”, CISSP, Publisher- John Wiley & Sons, 2011

ELS 507 - Nano Electronics

Course Outcomes:

1. The overview and importance of nanotechnology in the technological era.
2. Study the different fabrication techniques.
3. Discuss the types of characterization and applications of nano layers.
4. Study on innovative electronic devices based on nanostructure.

Unit I

Nanoscience and Nanoelectronics: Introduction to Nanoscience and Nanoelectronics, Nanostructure in nature, Bright future of Nanoelectronics. **Nanolayers:** The top down and bottom up approach, Fabrication of nanoparticles: Working Principle of High energy ball mill and Sol Gel Process. Production of Nanolayers, Types and working of PVD (Physical Vapour Deposition), Types and working of CVD (Chemical Vapour Deposition).

12 Hours

Unit II

Characterization of Nanolayers: Characterization of Nanolayers, Thickness, Roughness, Crystallinity, Chemical Composition, Optical properties, Application of Nanolayers. **Extension of conventional devices by Nanotechniques:** MOS Transistors, Structure and Technology, Electrical Characteristics of MOS Transistors, Limitations of Minimum Applicable Channels length, Low Temperature Behavior, Evaluation and Future prospects, Bipolar Transistors, Structure and technology.

12 Hours

Unit III

Innovative Electronic Devices Based on Nanostructures: General Properties, Resonant Tunneling Diode, Operating Principle and Technology. Quantum cascade Laser, operating principle and structure, Single Electron Transistor, Operating Principle and Technology, Applications, Carbon Nanotube Devices, Structure and Technology, Carbon Nanotube Transistors, Applications.

12 Hours

Books:

1) Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques by W.R Fahrner (Editor).
2) Nanotechnology-Nanomaterials and Nano Devices by G Mohan Kumar, Narosa Publishing House, New Delhi 2016.
3) Principles of Nanoscience and Nanotechnology by M.A Shah and Tokeer Ahmad Narosa Publishing House, New Delhi
4) Nano: The Essential understanding, Nanoscience and Nanotechnology by T Pradeep
5) Introduction to Nanotechnology, Charles P Poole Jr and Frank J Ownes, John Wiley Sons, Inc (2003)

ELE 509 – Data Communication Technology

Course Outcomes:

1. Understand the fundamental elements of data communication systems, signal types, transmission modes, and media.
2. Explain analog and digital modulation techniques used in communication.
3. Analyze various network topologies, transmission systems, and protocols across OSI and TCP/IP models.
4. Apply knowledge of IP addressing, Ethernet, Wi-Fi, and serial communication standards.
5. Identify and describe key communication devices, protocols, and applications in cloud and IoT systems.
6. Demonstrate an understanding of communication errors, data security principles, and modern network technologies including mobile and satellite systems.

UNIT 1

Principles of Data Communication

Basic elements of communication systems: source, transmitter, medium, receiver, **types of signals**: analog and digital, data types: text, voice, video, multimedia, **transmission modes**: simplex, half-duplex, full-duplex, communication media including twisted pair, coaxial cable, optical fiber, radio waves, microwaves, and infrared, **basic modulation techniques**: AM, FM, PM, **introduction to digital modulation methods**: ASK, FSK, PSK.

12 Hours

UNIT 2

Transmission Systems and Network Technologies

Network topologies: bus, star, ring, mesh, **types of networks**: LAN, MAN, WAN, overview of OSI and TCP/IP reference models and their layers, **IP addressing**: IPv4 and IPv6, basic understanding of Ethernet and Wi-Fi technologies, **fundamentals of multiplexing techniques**: TDM, FDM, WDM, **introduction to serial communication standards**: RS-232, RS-485, USB.

12 Hours

UNIT 3

Protocols, Devices, and Communication Applications

Communication devices: modem, router, switch, access point, **introduction to common protocols**: HTTP, FTP, SMTP, TCP, UDP, **basics of cloud and IoT communication** with examples like Alexa and smart meters, fundamentals of data security including encryption, HTTPS, digital signature, **understanding of communication errors**: noise, attenuation, parity check, checksum, mobile networks generations, satellite communication, and sensor networks.

12 Hours

Books:

1. **Introduction to Data Communications and Networking**, Wayne Tomasi, Pearson Education, 1st Edition, 2007
2. **Data Communications and Networking**, Behrouz A. Forouzan, McGraw-Hill Education, 4th Edition, 2017
3. **Data and Computer Communications**, William Stallings, Pearson Education, 10th Edition, 2017
4. **Computer Fundamentals**, P.K. Sinha, BPB Publications, 8th Edition, 2023
5. **Essentials of Data Communication**, N. Sreenivasan, S. Chand Publishing, 1st Edition, 2005