Course Code and Title with L-T-P Structure: **EL-540: Sensors and Sensor Intelligence (3-0-1)**
Semester : **2nd Semester**
Programme : **M Tech in ELDT**
Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Theory:

Unit 1: Classical sensors and transducers (10 hours):
Definition and classifications ; Working principle, materials and types of-Resistive sensors- potentiometer, strain gauge, RTD, thermistor; Capacitive- capacitive moisture, density and level measurement ; Inductive- RPM, flow measurement; Thermocouple; MEMS; Gas sensors ; Electrochemical sensors; ISFETs-glucose sensors; pulse, blood pressure and oxymeter

Unit 2: Intelligent Sensors (10 hours): Definition; Classifications- based on functions and techniques; Smart sensors- monolithic and hybrid; Soft sensors- modelling techniques, time sharing; Cogent sensors-monotype and multitype, classification, semantic transformation and decision making; Self adaptive sensors- adaptation to accuracy, time, power consumption and linearity;

Unit 3: Intelligent signal processing (10 hours): Metrological intelligence; Linearization techniques-circuit based linearization- OPAMP based, nonliner ADC; Look-up table; Piece- wise linearization; Interpolation; Error and drift compensation; Circuit based compensation- dummy circuit; Temperature compensation; Frequency based sensor- sensitivity control;

Unit 4: Artificial intelligence (10 hours): Human intelligence and machine learning; Biological and artificial neuron; Hardware realization of Neuron; Array based sensors; ANN based classification and discrimination, Recurrent ANN; E-tongue and E-Nose; Prognostic, diagnostic and predictive techniques in medical science, Fuzzy logic based techniques

Total: 40 lectures

Course Outcomes (COs)

Towards the end of the course the student will be expected to –

1. explain and differential classical and intelligent sensors
2. illustrate sensor and its intelligence
3. explain various Intelligent Sensor Standards and Protocols
4. illustrate artificial and adaptive intelligence
5. apply various intelligent signal processing techniques
6. develop basic artificial and adaptive neural networks for signal processing

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology.			6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.			7	The graduates will have a good understanding of professional and ethical responsibility.	

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3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.			8	The graduates will be able to demonstrate effective communication skills, both written and oral.	
4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.			9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	
5	The graduates will have knowledge in the design of digital systems, micro-fabrication and intelligent systems.			10	The graduates will have a good understanding for the need of life-long learning and will be able to work in teams.	

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Course Code and Title with L-T-P Structure: **EL-517: Physical and Industrial Design of Electronics Systems (3-0-1)**

Semester : **1st Semester**

Programme : **M Tech in ELDT**

Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Translation of Product concepts to manufacturable designs, Product Design Methodology, Product Planning and Data Collection, Sources for New Ideas, Creativity Technique, Elements of Aesthetic, Ergonomics of Electronic Equipment, Control panel Layouts, Computer Aided Physical Design, Structuring, Layers, Structural Design, Layout of Components, Product detailing and Value Engineering, Packaging, Thermal Management of Electronic Equipment, System operating Characteristic.

Course Outcomes (COs)

At the end of this course students will demonstrate the ability to:

1. Analyse functional and design aspects of existing products for identifying opportunities for improvement and modification for generation of creative product ideas
2. Design user-machine interfaces using the concepts of ergonomics
3. Communicate design solutions using dummy, semi functional and fully functional models or prototypes
4. Apply the concepts of product management and design in assessment and intervention of product life cycle

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology.	1, 2, 3, 4		6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	1, 2
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.	1, 2, 3, 4		7	The graduates will have a good understanding of professional and ethical responsibility.	3, 4
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	1, 2, 4		8	The graduates will be able to demonstrate effective communication skills, both written and oral.	1, 3
4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.	2, 3, 4		9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	1, 2, 3, 4
5	The graduates will have knowledge in the design of digital systems, micro fabrication and intelligent systems			10	The graduates will have a good understanding for the need of life-long learning and will be able to work in teams.	1, 3

Course Code and Title with L-T-P Structure: **EL-531: Design of Digital Systems (3-0-2)**
Semester : **1st Semester**
Programme : **M Tech in ELDT**
Course Offering Department : **Electronics and Communication Engineering**

Syllabus

IEEE logic Notation, Polarised Mnemonic Convention & Dependency Notation, Designing Combinational Circuits, MSI & LSI Circuits & their applications, Multiplexers & Demultiplexers, State equation & other diagram representation of sequential circuits, Realisation of sequential functions using Gates/Flip-Flop, counters & Registers, Structure of General Digital Systems, System Controls, Timing & Frequency considerations, Design Phases & System Documentation, Programmable Logic Device, Classification (PAL, PLA, & EPLD) , Design with PLD's the associated development tools, Case Studies, Microprocessor Architectural Concepts, Microprocessor instructions & Communication, Micro-controller, Motorola 68xxx family microprocessors, Architecture & Instruction Set, Microprocessor Input Output Interface, Design of Microprocessor based Systems & Testing, Design Tools for Microprocessor based System Design.

Course Outcomes (COs)

At the end of this course students will be:

1. able to design the combinational circuits
2. able to design the sequential circuits
3. able to understand the concepts of design with PLDs, Architecture of Microprocessor and Microcontrollers
4. able to design and analyse Microprocessor and Microcontroller based Systems

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology.	1,2,3		6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	1,2,3,4
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.	1,2,3,4		7	The graduates will have a good understanding of professional and ethical responsibility.	nil
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	1,2,3,4		8	The graduates will be able to demonstrate effective communication skills, both written and oral.	nli

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4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.	3,4		9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	1,2,3,4
5	The graduates will have knowledge in the design of digital systems, micro-fabrication and intelligent systems.	1,2,3,4		10	The graduates will have a good understanding for the need of life-long learning and will be able to work in teams.	1,2,3,4

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Course Code and Title with L-T-P Structure: **EL-523: Advanced Programming Language (3-0-1)**
Semester : **1st Semester**
Programme : **M Tech in ELDT**
Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Introduction to Object Oriented Programming (OOP) & its applications, Differences between OOP and Procedure-Oriented Programming (POP), System Input/Output streams, Functions, Defining Classes and Objects, Constructors and Destructors, Operator Overloading, Function overloading, Inheritance, Pointers, Virtual functions, Polymorphism, Templates and exception handling, Managing console I/O operations, Working with files, Graphics Programming. Introduction to MATLAB, and its Applications, Executable C code in MATLAB Programming (Laboratory will be based on C++ and MATLAB)

Course Outcomes (COs)

1. After completion of this course, students will have basic knowledge of the Object oriented programming (OOP).
2. After completion of this course, students will have basic knowledge of the MATLAB
3. Students can utilize the knowledge of OOP & MATLAB in engineering problem solving.
4. Students are expected to do their final year project work using the C++ compiler and/or MATLAB

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology.	1,2,3		6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	4
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.	4		7	The graduates will have a good understanding of professional and ethical responsibility.	
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	4		8	The graduates will be able to demonstrate effective communication skills, both written and oral.	
4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.			9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	
5	The graduates will have			10	The graduates will have a	4

	knowledge in the design of digital systems, micro-fabrication and intelligent systems.				good understanding for the need of life-long learning and will be able to work in teams.	

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Course Code and Title with L-T-P Structure: **EL-533: Data Communication & Networks (3-0-2)**
Semester : **1st Semester**
Programme : **M Tech in ELDT**
Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Data Transmission:
Analog and Digital transmission, Transmission Impairments, Wireless Transmission Media – microwave and satellite, Guided transmission media – twisted wire, coaxial cable and optical fiber.

Data Signaling:
Encoding of Digital Data to Digital signal, Digital Data to Analog Signal, Analog Data to Analog signal and Analog Data to Digital Signal. Spread Spectrum Signaling, Data Communication Interface, Data Link control-stop & wait protocol, sliding window protocol, select & reject ARQ etc., Multiplexing – FDM, TDM, WDM.

Data Communication Networks:
Circuit Switched Networks (CSN)– switching concept, routing in CSN, control signaling, Network Security. Packet Switched Networks (PCN) – principles routing in PCN, congestion control, X.25. Asynchronous Transfer Mode (ATM) Networks – Protocol architecture, ATM logical connections, ATM cells, Transmission of ATM cells, Traffic and congestion control. Local Area Networks – architecture Bus, Star, ring and tree LANS, Medium excess control, CSMA/CD, Token ring, wireless LANS etc.

Protocol and Architecture:
OSI model, TCP/IP Protocol, IPv4, IPv6, Connectionless internetworking, Routing Network, Wide Area Networks, Fiber Optic Networks, ISDN - ISDN Channels & Interface, All Optical Networks-WDM Optical Networks, Photonic Switch Networks, Wavelength routing networks.

Course Outcomes (COs)

At the end of this course students will demonstrate the ability to

1. Apply data transmissions in the design of computer networks
2. Apply data signaling for making design of MODEM for WAN, Nation wide network
3. Apply circuit switched and packet switched networks in LAN
4. Apply data communication protocols in internet
5. Apply high bandwidth protocols in high speed communication networks such as WDM, Photonic switched networks

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology	1,2,3,4,5		7	The graduates will have a good understanding of professional and ethical responsibility.	4,5
2	The graduates will	1,2		8	The graduates will be able	1,2

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	demonstrate an ability to analyze, formulate and solve problems related to innovative product design.				to demonstrate effective communication skills, both written and oral.	
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	3,4,5		9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	4,5
4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.	2,3,4		10	The graduates will have a good understanding for the need of life-long learning and will be able to work in teams.	3,4,5
5	The graduates will have knowledge in the design of digital systems, micro fabrication and intelligent systems.	1,2				
6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	3,4,5				

Course Code and Title with L-T-P Structure: **EL-516: Design of Fine Mechanics and Power Devices (3-0-2)**

Semester : **2nd Semester**

Programme : **M Tech in ELDT**

Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Survey of Mechanical Components assembly & Systems for Fine Mechanics Applications. Basic Mechanical Laws & Analysis of Load Characteristics for actuator selection & coupling. Measurement of mechanical Parameters. Introduction to various incremental motion systems. Principle of operation & classification of various types of stepper motors. Controls & drive circuits. Improved control & drive techniques in open & closed loop. Use of DC motor in incremental motion systems & related control techniques.Use of permanent magnets. Design of sensors (Optical Encoders etc.). Design of Actuators (Electromagnets, Step motors etc.). Design & Fabrication of Pulse & Rectifier Transformers. Operation & Characteristics of power semiconductor devices like Thyristors, MCTs, SITHS, RCTs, GTCs, IGBTs etc. Drive & Protection of PSDs. Cooling of PSDs. PCB design aspects of power circuits. Linear & Power switching converters.

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. Apply concepts of incremental motion controls in real life applications
2. Choose type of stepper motors and design drive circuits for specific applications for stepper motors to suit particular applications
3. Evaluate, compare and choose the type of PSD and design efficient drive & protection circuits appropriate for specific applications
4. Apply the principles of PCB layout specific to power electronics

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)00

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology.	1, 2, 3, 4		6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	2, 3
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.	2, 3, 4		7	The graduates will have a good understanding of professional and ethical responsibility.	
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	2		8	The graduates will be able to demonstrate effective communication skills, both written and oral.	3
4	The graduates will have knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.	2, 4,		9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	1
5	The graduates will have knowledge in the design of			10	The graduates will have a good understanding for the need of	2, 3

	digital systems, micro fabrication and intelligent systems.				life-long learning and will be able to work in teams.	

Course Code and Title with L-T-P Structure: **EL-530: VLSI Design (3-0-2)**
Semester : **2nd Semester**
Programme : **M Tech in ELDT**
Course Offering Department : **Electronics and Communication Engineering**

Syllabus

Basic VLSI Design: Fundamentals of CMOS &BiCMOS, Scaling of CMOS Devices, CMOS, Digital Circuit Design, CMOS Analog Circuit Design, VLSI Design Methodology, Scaling of MOS Circuit, Stick Diagram & Lay out – λ-rules, System Design – FSM – Model, ASM Chart.

VLSI Physical Design: ASIC Design Flow, Top Down Approach, Bottom up approach, Partitioning – Approximation of Hyper graphs with graphs, Kernighan – LIN, heuristic, Ratio cut partitioning, Genetic Algorithms Based portioning, F. M. partitioning, Floor Planning – rectangular dual graph approach to floor planning, hierarchical approach simulated annealing, Floor plan sizing, Placement – Cost function, force directed approach, placement by simulated annealing, regular placement, partitioning placement, Routing – Line Searching, Steiner Trees, Maze Running, Global Routing – sequential approaches, hierarchical approach randomized routing, linear programming etc., Detail Routing – channel routing, switch box routing, routing in Field Programmable Gate Arrays (FPGA), array based and row based. Lay out Methodologies, Packaging.

Course Outcomes (COs)

At the end of this course students will demonstrate the ability to

1. Apply CMOS digital circuit in preliminary design of digital IC and processor
2. Apply CMOS analog circuit in preliminary design of analog IC
3. Apply CMOS analog and digital circuit in mixed circuit design of IC
4. Apply computer aided tools such as partitioning, floor planning, placement and routing in ASIC design of high held processor design
5. Apply Layout design and packaging design for the fabrication of ASIC

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

SN	Program Outcome (PO)	CO		SN	Program Outcome (PO)	CO
1	The graduates will demonstrate knowledge and concepts which are competitive for application in electronics design and technology	1,2,3,4		7	The graduates will have a good understanding of professional and ethical responsibility.	4,5
2	The graduates will demonstrate an ability to analyze, formulate and solve problems related to innovative product design.	1,2,3,4,5		8	The graduates will be able to demonstrate effective communication skills, both written and oral.	1,2,3
3	The graduates will develop an ability to design and implement projects and carry out research in interdisciplinary and emerging areas.	1,2,3,4		9	The graduates will display an ability to contribute in the transformation of the economy through knowledge-based initiatives.	4,5
4	The graduates will have	5		10	The graduates will have a	3,4,5

	knowledge and training on translation of product concepts to manufacturable designs, methodology of product design and ergonomics of electronic equipment.				good understanding for the need of life-long learning and will be able to work in teams.	
5	The graduates will have knowledge in the design of digital systems, micro fabrication and intelligent systems.	1,4				
6	The graduates will have good background for progression onto research programs and competitive examinations of national and international repute.	1,2,3				

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EL521: Design & Technology of Electronic Devices

Syllabus

Theory:

Unit 1: Review of microelectronic devices (10 lectures)

Introduction to MOS technology and related devices. MOS transistor theory.

Unit 2: Scaling theory (7 lectures)

Scaling theory related to MOS circuits, short channel effect and its consequences, narrow widtheffect, FN tunneling.

Unit 3: Multi-gate Transistor(5 lectures)

Double gate MOSFET, Cylindrical MOSFET

Unit 4: CMOS circuits and logic design (6 lectures)

Basic concept of CMOS circuits and logic design. Circuit characterization and performance estimation, important issues in real devices. PE logic, Domino logic, Pseudo N-MOS logic- dynamic CMOS and Clocking, layout design and stick diagram, CMOS analog circuit design, CMOS design methods.

Unit 4: SOI Technology (5 lectures)

Introduction to SOI, Multi layer circuit design and 3D integration.

Unit 4: Fabrication Steps of a MOSFET (7 lectures)

CMOS processing technology: Crystal grown and Epitaxy, Film formation, Lithography and Etching, Impurity doping, Integrated Devices.

Total: 40 lectures for theory

Practical:

Experiment 1: Study the diode characteristics using Matlab

Experiment 2: Simulate the diode structure with Sentaurus device Simulator and compare with experiment-1

Experiment 3: Study the BJT characteristics using Matlab

Experiment 4: Simulate the BJT structure with Sentaurus device Simulator and compare with experiment-3

Experiment 5: Study the MOSFET characteristics using Matlab

Experiment 6: Simulate the MOSFET structure with Sentaurus device Simulator and compare with experiment-5

Experiment 7: Study the Short channel characteristics of a MOSFET using Matlab

Experiment 8: Simulate the Short channel characteristics of a MOSFET with Sentaurus device Simulator and compare with experiment-7.

Total: 16 hours for practical

Course Outcomes (COs)

1. Understand the fundamental principles of electronic devices
2. Understanding of need of a new device for higher performance and low power
3. Designing circuits with MOSFETs
4. Understanding the fabrication steps of a MOSFET.

EL538: Advanced Electronic Devices

Syllabus

Theory:

Unit 1: MOSFET Devices (3 lectures)
Introduction to Long Channel devices and their mathematical modeling. Introduction to Short Channel devices.

Unit 2: Short channel Devices (7 lectures)
Introduction to Short Channel devices and their mathematical modeling. Different short channel effects: drain-induced barrier lowering and punch through, surface scattering, velocity saturation, impact ionization, hot electrons.

Unit 3: Nano scale MOSFETs: (9 lectures)
Quantum effects and Single-electron charging effects in nano scale Si- MOSFETs. Double gate and all around MOSFETs, Nano-wire MOSFETs.

Unit 4: Hybrid Electronic Devices (12 lectures) Introduction to Hybrid Electronic Devices , Electrolyte-Insulator-Semiconductor (EIS) structure, Site binding Theory. MOSFET based Bioelectronic Devices: Ion sensitive Field Effect Transistor (ISFET), Reference Field Effect Transistor (REFET), Measurement with ISFETs. Interfacing of Biological molecules with Electronic elements: Enzyme kinetics, Enzyme Field Effect Transistor (ENFET), Biological Field Effect transistor (BIOFET).

Unit 5: Modeling of FETs (6 Lectures)
Modeling for short channel effects, Nano scale devices, ISFET, ENFET and BIOFET.

Total: 37 lectures for theory

Practical:

1. Modeling of potential and threshold voltage of long channel MOSFET (MATLAB)
2. Modeling of drain current of long channel devices (MATLAB)
3. Modeling of potential of short channel MOSFET (MATLAB)
4. Modeling of drain current short channel MOSFET(MATLAB)
5. Repeat exp.1 with TCAD simulation and compare with MATLAB results and analyze
6. Repeat exp.2 with TCAD simulation and compare with MATLAB results and analyze
7. Repeat exp.3 with TCAD simulation and compare with MATLAB results and

analyze

8. Repeat exp.4 with TCAD simulation and compare with MATLAB results and analyze
9. Potential model of ISFET
10. Potential model for enzyme FET

Total: 20 hours for practical

Course Outcomes (COs)

1. Basis understanding of electronics devices.
2. Connect the understanding of electronic devices to understand bioelectronics devices
3. Design bioelectronics devices for real life applications say, for medical applications.

EL546: Modelling and Simulation of Digital System

Syllabus

Introduction: Modeling digital systems, Design Methodology, Hardware modeling languages.

Introduction to Hardware description languages (HDL): *Introduction to VHDL*- Entity, Architecture, Modeling styles, Data Types and Operators, Flow controls, Generics and Configurations, Subprograms, Attributes, Packages and Libraries, Model simulation and interface with example code. *Introduction to Verilog Language Constructs*: Modules, programs, subroutines, package, Data Types and Operators, Loops and Flow control- for Loop, While Loop, The Case Statement, Simulation Flow if an if-Else Constructs, Tasks and Functions, Timing and delays, Simulation and Synthesis tools.

Combinational Circuits: HDL modeling of combinational Circuits, Combinational Components and Circuits, Decoders and encoders, Multiplexers and Demultiplexers, Priority encoder, Priority decoder, Comparators, Adders.

Sequential Circuits: HDL modeling of Sequential Circuits, Counters, Registers, State machine design, Sequential Data paths and Control, Clocked Synchronous Timing Methodology.

Programmable logic devices: programmable logic design techniques, modular designs and hierarchy, Read Only Memory (ROM), Programmable Read Only Memory (PROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL), field programmable gate arrays (FPGAs) and complex programmable logic devices (CPLDs).

Laboratory:

Introduction to hardware Modeling and Simulation in VHDL and Verilog, Implementations of digital systems on FPGA platforms, Design and implementation of Registers, Counters, State Machines, Traffic light Controller, Arithmetic Logic Unit Modeling , Design and implementation of a Simple Central Processing Unit

Course Outcomes (COs)

Upon completion of the course, the student will be able to

1. Understand various constructs and conventions of VHDL and Verilog.
2. Analyse and design combinational and sequential digital systems using VHDL and Verilog.
3. Simulate various digital system in VHDL and Verilog and implement the system in FPGA.
4. Work in teams in the design and implementation of an application of digital system using VHDL and Verilog.