

Integrated Program in Electronics and Communication Engineering

Semester	Courses for Electronics and Communication Engineering		
	Course Name	Credits per course	Number of Courses
I	Engineering Graphics and Design	3	1
II	A Professional's Approach to Law and Ethics (2022 Batch) Design Thinking and Creativity (2023 Batch and subsequent)	3	1
III	i) Applied Industrial IoT ii) Industrial applications of Microcontrollers – A Practice based Approach (2023 Batch and subsequent)	3	1
IV	i. Cyber Physical Systems for Industrial Applications (2022 Batch) ii. Applied Industrial IoT (2023 Batch and subsequent)	3	2
V	i) Drone Technology ii) Cloud Adoption and Management Techniques	3	2
VI	i) 5G Technology for Smarter & Secure Connectivity ii) AI and Edge Computing	3	2
VII	i. Renewable Energy and Power Evacuation ii. Chip based VLSI Design for Industrial Applications	3	1
Total			10

Engineering Graphics & Design

Unit 1	Basics of Engineering Graphics, Projection of Points & Lines
Introduction to Engineering Drawing, Manual & Computer-Aided Design, and Drafting, Lettering, Dimensioning, Geometrical Constructions, Plane Curves, Conic Sections, Cycloidal Curves, Involute – Projection of point placed in a quadrant – Projection of a line using first angle projection method, rotating line method, trapezoidal plane method – Solve & draw projections of a line kept inclined to two planes – Determination of true length, true inclinations & traces of a straight line.	

Unit 2	Projection of Planes & Solids
Description of plane shapes & solids - Drawing plane projections & solids using change of position and auxiliary plane method – Projection of solids with inclined axis – Drawing projection of solids using change of position and auxiliary plane method.	

Unit 3	Orthographic Projections & Sections of Solids
Visualization & drawing orthographic projections – Description & drawing of Plan, elevation, side elevation of objects, simple machine parts using first angle projection method – Description of section plane & a portion of solid – Drawing sectional top view, front view, the true shape of the section on an auxiliary plane	

Unit 4	Isometric & Perspective Projection, Development of Surfaces
Drawing isometric view of solids (Box method) – Drawing isometric scale & construction of isometric projection from orthographic projection – Drawing perspective projection of small, and large objects and building components using suitable methods – Drawing section plane & determining lateral surface – Determination of the shortest distance between points – Drawing & determining the shape of metal sheet to cut objects	

Unit 5	Building Drawing, Solid Modeling, Building Information Modeling
Drawing plan, elevation, and sectional elevation of a small residential & office building – Description & creation of Solid models in general and with respect to engineering – Designing and creating a new product & generating various views – Basics of Building Information Modeling (BIM)	

A Professional's Approach to Law and Ethics

Unit – I

General Principles of Contracts Management : General Principles of Contract, Competency and Enforceable Contracts- Various Types of Contracts and their Features- Government Contracts - Tenders, Request for Proposals and Bid Evaluations- Specific Contract- Insurance, Taxation, Contract Documentation- Performance , Joint Liabilities, Impossibility, Excusable Non-performance and Doctrine of Frustration- Breach of Contract, Consequences, Remedies- Specific Performance and Sale of Goods Act- Public /Private Partnerships- Build, Own, Operate and its Variations- Engineering Contracts, Standard Issues, Certification process and Issues relating to the Final Bill- FIDIC Model Contracts

Professional Ethics: Definition Types and Theories of Ethics- Code of Ethics and Professional Ethics - Gift vs. Bribery and Anti-corruption Laws - Whistle Blowing and Vigil Mechanism - Confidentiality Information and Data Protection - Tortious Liability -Environmental Breaches and Disaster Management - Discrimination at Workplace

Unit - II

Arbitration and Mediation : Introduction and Evolution of Arbitration Law Salient -Arbitration Agreements -Notice of arbitration and appointment of arbitrators - Seat v. Venue- Procedure to be followed by arbitral tribunal and jurisdiction of arbitral tribunal- Interim orders and How to challenge them- The Arbitration & the Award - Challenging the Arbitral Award - Arbitration's beyond India's borders- SIAC & LIAC - Enforcement of Foreign awards - Dispute Resolution Boards & Lok Adalats - Difference between Arbitration, Mediation, Conciliation and Negotiation - Alternate Dispute Resolution methods and Confidentiality

Unit - III

Corporate & Commercial Laws : Basic definitions and terms under Company Law- Difference between Companies and other entities - Articles and Memorandum of Association - Authentication of contracts and documents - Piercing of Corporate Veil -Corporate Social Responsibility - Appointment of Directors and Managerial Personnel- Mergers and Amalgamations- Offences Punishable under Companies Act - Adjudicating Authority under Companies Act - Landmark Judgments under Company Law - Basic Definitions and Terms under Insolvency Code - Overview of CIRP Process - Overview of Liquidation Process - Insolvency of Micro, Small and Medium Enterprises (MSME)- Insolvency Process for Personal Guarantors - Landmark Judgments under Insolvency Code - Competition Law - Anti-competitive agreement - Abuse of dominant position - Merger Control Regulations - Landmark Judgments under Competition Law

Unit - IV

Taxation : India Income-tax Introduction and Concepts - TDS-TCS Advanced Tax - Filing return of income - Tax Incentives for commercial entities - Exchange control regulations in India – FEMA - Basic terms and fundamentals - GST- Input tax credit - Customs Duty, FTP & SEZ

Engagement of Labour, and other construction related laws : Industrial Disputes Act - Building and other construction related laws - Sexual Harassment at Workplace - Health and Safety Laws - Environmental Protection laws - Social Security Laws - Labour codes and impact on construction industry

Environmental Protection laws : Environmental Laws in India - Understanding sustainable development - Environmental Impact Assessment an overview - Overview of International Conventions on Environmental Protection

Unit - V

Intellectual Property Rights (IPR) : Intellectual Property Law in India - Copyright and Trademarks - Patents and Designs - Product/ Process Patent and Terminology Role of -engineering students in Patent offices - Preparation of patent documents - IP in engineering companies- Trademarks - definition, concepts, registrable, non-registrable - Domain name and WIPO domain name process – Trademark & Copyright registration process - Computer programs and Copyright - Idea vs expression dichotomy- Designs registration process -Protection of trade sectors in India - Online Piracy - the Law in India - Competition and Confidentiality Issues, Antitrust Laws - Assignment and licensing of IPR – Patent, Trademark, Copyright, Design : infringement and remedies - IP issues in sale of business- Start-ups and IP- Software and Business Method Patenting in India & other Jurisdiction - Ownership of IPR and employment rights

Design Thinking and Creativity

Unit - I: Critical Thinking

Introduction to Critical Thinking, Styles and challenges of Critical Thinking, Benefits of Critical Thinking, Identifying & clarifying issues and arguments, Types of Arguments, Common patterns of Deductive reasoning & Inductive reasoning, Reasoning with Statistics, Fallacies of Relevance, Fallacies of Insufficient Evidence, Evaluating arguments, Critical Thinking models, Principles of Decision making, De Bono's Thinking hats, Effective Argument Writing, Critical Thinking based case study analysis, Analytical view of Science & Pseudoscience based thinking

Unit – II: Design Thinking Fundamentals and Framework

Fundamentals of Design Thinking, Design Thinking for complex problem solving, 7-stages of Design Thinking, Problem and solution spaces, Techniques of Empathy building, Empathy maps and user journey mapping, Storyboarding and role-playing, Exploring solution space, Design Thinking practising use – cases, Design Thinking for Professional Skills, Design Thinking practices for Coding skill, Co-curricular skill, Technical blog writing, Contest preparation, Designing Capstone projects, Design Thinking in industrial projects, Strategy for new technology innovations

Unit – III: Design Thinking in Creativity & Innovation

Unique characteristics of Design Thinking, Difference between Creativity and Innovation, Categories and misconceptions of creativity, Resilience in problem-solving, Analytical Thinking – Driven by Design Thinking, Case study on collaborative creativity enhanced by Design Thinking, Waterfall models and Design Thinking, Agile Development models, Agile process integrated with Design Thinking, Different use-cases, and project problem statements, Design Thinking based Product development - Design methodology, Prototyping, UX design, Value proposition, Business model

Unit – IV: Leadership and Teamwork

Defining leaders and leadership, Types of leaders and leadership styles, Understanding the people, personalities and abilities, Active listening, Non - verbal communication, Feedback, Clarity, Effective teams, Stages of team development, Understanding the psychology of change for individuals and teams, Personal resilience and well- being, Feedback and feed forward, Leaders and teams: Working effectively towards common goals, Role of integrity in leadership, Embracing growth mindset in leadership, Conflict resolution and Managing team dynamics

Unit – V: Verbal and Non-verbal Communication

Verbal and non-verbal communication, LSRW skills, Assertive communication, Persuasion Skills, Interpersonal Skills, Cross-cultural communication, Emotional intelligence, Self - awareness, Interpreting body language, Active listening, Personality development, Time management and Goal setting

Applied Industrial IoT

Unit – I: Introduction to Industrial IoT & IoT Architecture

Phases of Industrial Revolution, Concept of Internet of Things, Summary: Overview of Industrial IoT, Drivers, Benefits and Challenges of IoT, Summary of Drivers and Challenges in IIoT, Categories of IoT.

Information and Operational Technology, Layers of IIoT Architecture, Functions of IIoT Architecture Layers, Summary of IoT Architecture, Summary of IoT Layered Architecture, Solar Plant Management, Utility Monitoring in Railways, Components of IIoT Architecture, Introduction to On-premise servers and Cloud, Review of Components in the First two layers of IoT, Review of Components in the Network Layer of IoT, Review of Components in the Application Layer of IoT, Review of the Server architecture in IoT, Annunciator Monitoring.

Unit – II: Data Acquisition

Fundamentals of Sensors, Types of Sensors, Some Common Sensors, Choosing a Sensor, Review of Sensor Fundamentals, Review of Different Types of Sensors, Review of Selection of Sensor,

Pharma Industry, Pharma Industry, Electricity cost distribution in commercial buildings, Electricity cost distribution in commercial buildings, Demo - Energy Measurement, Sensor Technologies, Thermal Sensors, Pressure, Shear and Photo Sensors, Electrical, Magnetic and Mechanical Sensors, Corrugated boxes, Bottling plant, Introduction to Measurements and Direct Measurement, Indirect Measurement, Derived Measurement, Measurement from Industrial Systems, Summary of Concepts of Measurements and Direct Measurement, Summary of Indirect and Derived Measurements, Measurements from Industrial Systems and Calibration, Energy monitoring in Casting process, Heavy Equipment Forging

Unit – III: The Edge Computing

Edge Computing, Gateway Overview, Types and Features of Gateway, Overview of Edge Computing, Summary: Overview of Gateway, Selecting a Gateway, Packaging Industry, Bottle Manufacturing, IoT Gateway, IoT Gateway Hardware, Choice of Gateway, Configuring the Gateway, IoT Video Analytics and Quality Control at the Edge, Summary of the Fundamentals of an IoT Gateway, Summary of the IoT Gateway Hardware and Configuration, Summary of Choice of Components in a IoT Gateway, Automotive Component Manufacturing, Aluminum Extrusion.

Unit – IV: IoT Connectivity Protocols

IoT Connectivity Overview, Wireless Long Range (WAN) Protocols, Wireless Short Range Protocols IIoT Example of Sensors and Gateway - Wheel Loader, Summary of IIoT Connectivity, Summary of IIoT Wireless Short- & Long-Range Protocols, Automotive Component Casting, Tool Bit Manufacturing, LAN Protocols, Serial Protocols, Optical Networks, Transmission Protocols in IoT, Choice of Protocols, Industrial IoT Example - Smart City, Wired LAN and Fiber Optic Protocols, Serial Protocols in IIoT Solutions, Review of Transmission Protocols, Fasteners – Production Monitoring, Bucket Wheel Excavator Monitoring, Demo - Linear Level Transmitter

Unit – V: Platform Architecture & IIoT Security

Platform Architecture Overview, Types of Server Architecture, Data Architecture, Data Ingestion and Stream Processing, Smart Monitoring of Diesel Generators, Review of the Fundamental Concepts of Platform Architecture, Review of the Different Types of Server Architecture, Big Data Architecture and Stream Processing, Aerospace Parts Manufacturing, Metal Stampings, Demo - Pulse counting with Control Input, Storage Devices, Storage Technologies, Storage Dimensioning, Database, Summary of Storage Devices and Technologies, Review of Storage Dimensioning, Databases and Data Lakes, Polymer Extrusion, Steam Turbine Monitoring, Analytics Overview, Types of Analytics, Algorithms and Machine Learning, Visualization, Summary of Data Analytics, Summary of Algorithms and Machine Learning, Summary of Visualization, Examples of Different Algorithms, Diesel Generator Monitoring, Diesel Generator Monitoring, Water Management in Public Utilities, Water Management in Public Utilities, Demo - Flow Sensing with Totalizer.

IIoT Security Concerns, IIoT Device Security, IIoT Connection Security, IIoT Application Platform and Cloud Security, Threat Modelling, Industrial Example - IoT Connected Workplace Solution, Summary of IoT Security, Securing Access, Authenticity and Data in IoT Solution, Review of Concepts of Threat Modelling, Bulk Milk Cooler Monitoring, Air Compressor Monitoring

Industrial Applications of Microcontrollers – A Practice based Approach

Unit – I: 8-bit Microcontroller Architecture and Features

Introduction to Microcontrollers, Basics of 8-bit Microcontroller (8051), Pin Diagram and details, Functional Diagram – 8051, Functional Block Diagram, Memory Organization, Stack and Stack Pointer, Special Function Registers, I/O Ports Configuration, P0 to P3 Programming, Simulator Kickstart, External Memory Interface, Memory Interfacing, Timers and Counters, Modes of Timers and Counters, Serial Transmission of Data, Serial Reception of Data, Serial Mode Communication Device, Interrupts - External & Internal, Interrupts – Control, Interrupts – Priority, Microcontroller Instruction Set Architecture, Addressing modes of 8051

Specific Use Cases:

1. EdSim 51 Simulator
2. Schematic design
3. PCB Design and Firmware integration basics
4. LEDs and Switches configuration in EdSim 51
5. Walkie – Talkie controller model
6. RFID in POS
7. Automotive Embedded System

Unit – II: Programming Techniques and Communication Interfaces of Microcontroller

Data movement and Logical Instructions, Bit operations and Examples, Arithmetic Operations - Addition & Subtraction, Arithmetic Operations - Multiplication & Division, Example Programs – I, Jump instructions, Calls and Subroutines, Programming Interrupts, Programmable Interrupt Controller, Example Programs – II, Timer, Counter and I/O Programming principles, Timer programming – Example, Counter programming – Example, Input Port Programming - Example (Instructor Led), Output Port Programming – Example, Keyboard Interface, Seven segment Display Interface, Pulse Measurement, ADC/DAC Applications, Multiple Interrupts, Introduction about development boards-Microcontrollers, Principles of Cross Assembler, Testing simple 8051 programs, Executing programs in external memory, Communication interfaces for Microcontroller- UART, Communication interfaces for Microcontroller – SPI, Communication interfaces for Microcontroller – IIC, Software Development Principles: Microcontroller, Debugging Principles, Example Software framework

Specific Use Cases:

1. Bonus allocation in an Organization
2. Waveform Display
3. Emergency Ward Alarm
4. Coffee Vending Machine
5. Pulse Width Modulation

Unit – III: AVR Microcontroller – Basic Principles, Development board and Case Studies

AVR Microcontroller Architecture, AVR Microcontroller Features, Memory Organization for AVR MC, Peripherals for AVR MC, Software and Hardware Tools - AVR MC, Use cases Part I, Use cases Part II, Example project, Case Study - Development Board based on 8-bit AVR microcontroller, Overview on the Hardware, Development Board I/O Model, IDE of the development board, Electronic Components on the Board, Basic Program Part I, Basic Program Part II, Interfacing Input Devices: Switches, Interfacing Input Devices: Pushbutton, Interfacing Output Devices - Seven segment Display, Interfacing Output Devices - LCD Display, Interfacing Sensors - IR Sensor, Interfacing Sensors- Ultrasonic sensor, PWM control Configuration, Analog to Digital Conversion, Wireless Connectivity – Configuration, Use cases, Example Project

Specific Use Cases:

1. AVR Microcontroller Development Board
2. Microcontroller based Substation
3. Microcontrollers in IoT
4. Soil Health Analysis
5. Arduino Program

Unit – IV: Microcontroller Applications – UNO and ESP8266 Applications (Prototypes and Demos)

Microcontroller based Industrial Application - Course Description, Model of the course, Objectives- Mind map, Fundamentals of Arduino UNO Development Board, Introduction to Arduino IDE, Development of a Smart Parking Management System(SPMS) using AUDB, SPMS - Demo, Synthesizing a Low cost Electronic Voting Machine(EVM) using AUDB, EVM - Demo, Development of Automatic Animal Feeder System(AAFS) using AUDB, AAFS – Demo, Tinkercad simulation of AUDB, Fundamental principles and Architecture of ESP 8266 Development Board, Development of a Prototype for Energy Auditing Model using ESP8266 – Demo, Development of Elderly Care Monitoring system through Wearable sensors – Demo, Development of an Alert system for Rash driving and Anti accidents-Using ESP8266 – Demo, Development of a Smart Irrigation System using ESP 8266-Demo, Automating Inventory Control in construction site using ESP8266- Demo, Effective Management of Diesel Generator in Industrial Applications Using ESP 8266 - Demo

Unit – V: Microcontroller Applications – ESP32 Applications (Prototypes and Demos)

Smart HVAC System design using ESP8266 – Demo, Development of Air Quality Monitoring System(AQMS) in Smart Cities using ESP8266- Demo, Development of Safety Monitoring System for workers in Construction site using ESP8266-Demo, Fundamental principles and Architecture of ESP 32 Development Board, Development of line follower Robot for industries using ESP32 – Demo, Development of Pick and Place Robot using ESP32 - Demo, Development of Obstacle Sensing Mechanism for Autonomous Robot using ESP32-Demo, Development of an Object identification robot using a ESP32 - Demo, Truck load object counting system – Demo, Gateway - An Example Product and application, Use case – Cloud model for IIoT Data, Development of Diesel Generator(DG) monitoring system using a Gateway device (An Use-Case demo)

Cyber Physical System for Industrial Applications

Unit-I: Introduction to Cyber physical Systems & BareMetal C coding for ARM Cortex Processor

Introduction to Cyber physical Systems : Cyber physical Systems faces of Engineering, evolution of Processors , Making Processor Chips from Sand, Structural Units in Embedded Processor and Memory Systems, Sensors and Actuators in Cyber Physical Systems, Serial Communication Protocols, Wireless Communications, Cyber Security, Cloud-Edge Computing Framework for Cyber Physical Systems. **BareMetal C coding for ARM Cortex Processor:** Introduction to Architecture and peripherals of ARM Cortex Processor, Getting started with IAR Embedded Workbench. BareMetal C coding for Interfacing ARM Cortex Processor with Relay, Buzzer, UART driver development , UART and ADC interface ,Interfacing 16x2 LCD Matrix Key and Led, Stepper Motor

Unit – II: Embedded System Design using Embedded C and Micropython Programming

Introduction to STM32F103 Architecture of ARM Cortex Processor, Getting Started with STM32 Cube IDE with on board LED Blinking, Interfacing STM32F103F with OLED display , Humidity & Temperature Sensor , Ultrasonic Distance Sensor, Hall effect sensor, Sound Sensor , Current Sensor ,Voltage sensor , Soil Moisture Sensor, Tilt Sensor, Touch sensor **Using Embedded C, Raspberry Pi Pico:** Introduction To Raspberry Pi Pico, Getting started with Thonny IDE and Installing Micro Python for Pico , Blinking on board LED of for Pico Board using Micropython programming, Interfacing External LED Through Push Button With GPIO Ports Of Pico, Simple Traffic Light Control System With Pico, Interfacing PIR Sensor, 16x2 LCD Display using I2C Protocol, Interfacing ADC with Pico and displaying in OLED, Interfacing Ultrasonic Distance Sensor and displaying in OLED , Simple Weather Monitoring System, Interfacing 8x32 Dot Matrix LED using SPI Protocol with Raspberry Pi Pico, Interfacing Blue Tooth with Pico and Controlling Relay using **Micropython programming**

Unit – III: Applications of CPS from embedded perspective in Consumer Industry, Smart Civil Structures, Smart Cities

Consumer Industry: Applications of CPS from embedded perspective for Domestic Refrigeration Appliances, washing machines, Smart Petrol Filling Station , Weigh-In-Motion systems , Coffee machine, Smart induction cooktop, microwave oven, Vacuum cleaner, Smart Watch, Smart speakers, Smart homes. Demo of simple smart home automation with CPS Components using embedded C.

Smart Civil Structures: Necessity of smart civil structures, Sensors and sensory systems, Control devices and control systems for smart civil structures, Data processing systems for structural health monitoring and vibration control, Power supply and energy harvesting for smart civil structures.

Smart Cities: CPS applications in Smart Traffic Control System for Congestion Control, Smart Waste Management System, Smart Detection system of Underground Utilities, Smart Parking system, Smart Metering for Gas ,water, Smart Energy Metering, smart Wireless Occupancy and Camera Surveillance

Unit – IV: Applications of CPS from embedded perspective in Automotive Mechatronics and Healthcare Applications

Automotive Mechatronics: Basics of Mechatronics and Vehicle System Architecture, Electronics Control Unit, Automotive Networking and Bus System, Automotive Sensors and Measuring Principles, Electronic Transmission Control, Anti-Lock Braking System, Electronic Fuel Injection Control System, Electronic Power Steering and Drive adjustment Systems, Electronic Heating, Ventilation and air conditioning Control (EHVAC), Automotive Radar for Advanced Driver Assistance Systems (ADAS)

Healthcare Applications: CPS applications in Electronic Stethoscope and Heart Rate Monitor, Digital thermometer, Blood pressure monitor meters, Blood glucose meters, Ultrasound imaging, Magnetic Resonance Imaging (MRI), X-Ray and Computed Tomography (CT) medical imaging technology, Endomicroscopy and EEG monitoring. Demonstration of Remote Heart Rate Monitoring using Audrino Nano

Unit – V: Applications of CPS from embedded perspective in Hybrid Electric Vehicle, Industrial Motor Control and Robotics

CPS applications in 48-V Electrification Belt-Driven Starter Generator Systems in vehicles, EV Traction Motor Power Inverter Control, Hybrid Electric Vehicles (HEV)/EV On-Board Charger (OBC), HEV/EV wireless charging,

Permanent magnet synchronous motor (PMSM)/ Brushless DC (BLDC) industrial Motor Control, Switched Reluctance Motor Control, Universal Motor Control, Single Phase AC Motor Control, Demo of interfacing four DC motors of mini electric car with Audrino Nano

Robotics: Introduction to pneumatics and hydraulics system for robotics application, Controlling solenoid valves using microcontroller for pneumatics and hydraulics, 5DOF robotics and description and mechanical design using Hartenberg Principle, 5DOF robotics arm cyber system as cps components designing using **simulink**, Introduction to Ardiuno nano, getting started with Ardiuno IDE with led on board blinking, Interfacing servo motor using Arduino nano, Controlling servo motor with potentio meter using Arduino nano Controlling 5 servo motor with PCA9685 using Arduino nano, 5DOF robotics arm assembly and testing

Drone Technology

Unit – I

Introduction of Drone, Classifications & its applications:

Basics of Drone Technology, Evolution of Drones, Terminology of Drones, Potential field of Drones, Customizing of Drones, Classification of Drones based on weight, Range & Altitude and Applications of Drone.

Case Study: Drone usage in Agricultural & Solar power Industry

Unit - II

Aero Dynamics, Propulsion Techniques with power bank:

Force on Drone/flight, Rotation of Aerial system, Equilibrium, Stability Control of Roll, Pitch, Yaw & Throttle, Calculation of stability, equilibrium & control, Essentials of propulsion configuration, Parameters of propeller, Propeller Materials, Motor basics, types & selection Category, Essentials of Battery, Fundamentals of Wet Cell Battery with calculations , Basics of Dry Cell Battery with calculations, Battery selection based on High Energy Calculations, Selection of battery based on C-Rating calculation with an example, Selection of battery by Voltage and Discharge Calculations, Battery selection for real time applications

Case Study: Selection of propeller and motor for the real time applications

Unit - III

Control System Design, Simulation and Programming:

Fundamentals of Control system, design & simulation (CSDS), BLDC Motor Transfer Function in MATLAB, BLDC Motor Loop Analysis with MATLAB Calculations, DC Servo Motor with Transfer Function in MATLAB, Proportional Controller, Control System Simulation in MATLAB, Basics of Programming / App Development, Logical Programming, Integrated Development Environment (IDE) software's, Application Programming Interface (API), Drone Programming, MATLAB Simulation.

Case Study: Real Time Applications of analysis & system simulation using MATLAB

Case Study: Applications of programming /App development using MATLAB/PYTHON/IDE

Unit - IV

Drone Sensor, Telemetry System, Maintenance & Flying Regulations:

Introduction to types of Sensors with applications, Accelerometer, Magnetometer, Barometer Gyro Sensor, Distance Sensor, Time to Flight Sensor (ToF), Thermal Camera Sensor, Chemical Sensor, Radio & Wi-Fi Communication, GPS, First Person View Telemetry, Marine & Subsea Telemetry, Battery maintenance, Sensor maintenance, Motor & Propeller maintenance, Telemetry & Controller maintenance, Introduction to Safety & Drone Regulations, Safety Regulations in India & USA.

Case Study: Types of Sensors required for the Film Making and Product Delivery

Case Study: Required type of Telemetry system for the Product Delivery Drone

Case Study: What kind of maintenance needed for a agricultural drone

Unit - V

Development and Building of Drones, Pilot Certifications & Applications:

Selection of Parts of Drone, Frame, Propulsion System, Propeller Guards, Controller, Battery, List of Software, Testing & Verification, Building of Drone with Miniature Model, Expert talk on Drone pilot Training Certification.

Case Study: Specific Applications of Drone for Aerial View & Fertilizer Spray for Agricultural

Case Study: Specific Applications of Drone for Geo Spatial & Underwater Communication

Case Study: Specific Applications of Surveillance Drone for security

Cloud Adoption and Management Techniques

Unit I	Cloud Adoption – Overview, Strategy and Framework
<p>Adoption Trends and Managing Infrastructure, Cloud Deployment Models, Cloud Service Models, Building Blocks of Cloud</p> <p>The Need for Cloud Adoption Strategy, Cloud Migration Triggers, Cloud Innovation Triggers, Business Outcomes - Cost Savings, Business Agility, Operational Resilience and Customer Engagement</p> <p>Cloud Strategy Team Establishment, ROI Framework, Sample ROI with Cloud Benefits, Business Case Preparation, Cloud Adoption Readiness</p>	
Unit II	Choosing Cloud Provider
<p>Shared Responsibility Model - Customer vs Cloud Provider, Compute Capabilities of a Cloud Provider, Compute Instance Types and Sizes, Compute Instance Purchasing Options, Compute – Containers and Serverless</p> <p>Network Capabilities Expected from Cloud Provider, Network Connectivity Options and Load Balancing, Storage Capabilities, Database and Data Analytics Capabilities</p> <p>Overview about DevOps and Infra-as-Code, Cloud Provider Support and Ecosystem, Cloud Provider Service Levels and Vendor Lock-in, Finalizing the Cloud Provider</p>	
Unit III	Multi-cloud Adoption Framework and Cloud Readiness Assessment
<p>Introduction to Cloud Adoption Framework and its Needs, PASS Approach, m-CAF Viewpoint Areas, Using Cloud Adoption Readiness Tool (CART)</p>	

<p>Cloud Readiness Assessment – Objectives, Assessment Approach: Discovery and Data Collection Phase, Analysis and Reporting Phase, Application level FACT Assessment, Software Health and Cloud Ready Index for Application Code, Application Dependency Analysis and Service Mapping</p> <p>7R Migration strategy, Rehost Migration Strategy, Replatform and Refactor Migration Strategy, Rebuild and Replace Migration Strategy, Retain and Retire Strategy, Selecting the Right Migration Strategy</p> <p>Tools and Techniques for Cloud Assessment, Assessment Tools and its Use Cases, Migration Tools and its Use Cases, Identify Move Groups and its Scenarios, Migration Planning and Cost Analysis, Cloud Migration Checklist an Assessment Outcomes, Identify the Migration path and its trade-off, Concluding the Cloud Business Case</p>	
Unit IV	Cloud Migration and Modern Practices
<p>Landing Zone - Account Strategy, Network Services, Identity and Access Management, Security, Governance, Management</p> <p>Migration Techniques - Online, Offline and Live migration, Operational Excellence with modern practices, Modern DevSecOps Practices</p>	
Unit V	Cloud Operations, Optimization Techniques and Cloud Governance
<p>Improve Performance Efficiency, Monitoring for Operational Excellence & Performance Efficiency, Resource Tagging, Security and Compliance, Reliability, Deep Dive of Cloud Monitoring</p> <p>Cost Optimization, Apply Well Architected Framework and Principles, Achieving Cost Optimization using RI, Cost Optimization Scenarios using on-demand & RI, Explanation of each Pillar of well Architected Framework</p>	

5G Technology for Smarter and Secure Connectivity

Unit – I: Overview and Fundamentals of 5G Network - 5G RAN Architectures

Course Description, Cellular Networks Fundamentals, Evolution of Cellular Networks, 1G to 5G, 2G and 3G, Network Architecture and Planning, 4G Network Architecture - Core & RAN, Challenges and Limitations of 4G Networks - Use Cases Perspective, 5G Technology - Design Principles and Architecture Fundamentals, 5G for Socio-Economic Development, Components of 5G Technology Framework, Use-Case on 5G : Virtual Offices and Factories, Use-Case on 5G : 3D Transportation & Drones, Introduction to 5G RAT & RAN, CRAN, DRAN, VRAN & O-RAN, Generalized Open RAN Architecture, Open RAN Initiatives and Deployments, O-RAN Architectures, SMO, RIC and Interfaces, O-RAN Functional Splits, 5G NR Physical Channel Design and Structures, 5G DL and UL Channels, Massive MIMO, Beam Forming and Beam Steering and 5G Physical Layer Reference Signal.

Unit – II: 5G Network Architecture Design and Deployment Strategies - Computing Principles in 5G

5G Evolution - 3GPP Release 15 – 17, Essential Technologies of 5G - NFV, SDN, MEC, C-RAN, Non-Standalone 5G Network Architecture, NSA CUPS Architecture, Standalone Cloud Native 5G Core, 5G SBA Network Functions, Components of Slice, Slice Selection Procedures, 5G Slice Attributes, 5G Slicing Use Cases, Signaling in 5G Core, Network Management and Orchestration, Referral 5G Architecture and Modules of Computing, Edge computing Principles for 5G, 5G RAN - Computing Principles, 5G Core Network Computing, 5G Cloud Computing Principles, Osmatic and Catalytic Computing Techniques for 5G, Use case-1, Use Case-2, Use Case-3 and Simulation exercise-Demo.

Unit – III: Design and Development Tools for 5G-A Simulation Perspective

5G Network Design and Establishment - Issues and Challenges , 5G Technology Simulations – Scope , Choices of 5G Simulation Tools, Link level simulation - An Example (NYUSIM), Use case using NYUSIM, System Level Simulation - An Example (WISE), Use Case using WISE , 5G and Cloud Computing – Integration, API tools for integration , Example API Tools (RESTful and NFV), Introduction to Matlab/Simulink 5G Toolbox, Introduction to Communication and RF Toolboxes, Transport Channel Subcomponent Modeling, Physical Channel Sub Component Modeling, Downlink and Uplink Channel Modeling, NR Transmitter Design and Performance Evaluation, NR Receiver Design and Performance Evaluation, EVM Measurement, ACLR Measurement, End to End Uplink and Downlink Simulation, Performance Evaluation of NR with MIMO and Performance Evaluation of NR with Beamforming.

Unit – IV: 5G Impacts on IoT - 5G Networks Security Implications-A practitioner's approach

IoT Technology- An Overview, Relational Model between IoT and 5G(archi), 5G based IoT Architecture-Choices, Millimeter wave Communication for 5G_IoT_Application, IoT Hardware System with 5G support, Use Case-Supply chain management, Use Case-Smart City , Use case -Smart Agriculture, Use Case-Connected Car, 5G connected IoT -Simulation, 5G Network security -An introduction, Security evolution strategies in 5G(Use case), 5G Network architecture with security, 5G security in user equipment domain, The significance of 5G security in Network domain, Role of 5G security in operator Network domain, The importance of 5G security in the access and core Network domains, Formulating the idea of security in telecommunications Networks, Software tools for 5G Network security and Security measures for smart hospital environment utilizing 5G technology-Use Case.

Unit – V: 6G Technology and Specifications

Key Drivers and Research Challenges for 6G, 6G and UN SDG Relation and Key Indicators, 6G Platform Based Ecosystemic Business Models, Business Vertical Productivity Enhancement with 6G, 6G for Last Mile Connectivity of Remote Areas, Machine Learning in 6G, Edge Computing and Intelligence in 6G, Broadband Networking with 6G, URLLC with 6G, Machine Type Communication with 6G, Privacy, Security and Trust Challenges of 6G and Significance of Block Chain in 6G.

AI and Edge Computing

Unit – I: Artificial Intelligence (AI) and its Next Wave - Edge Computing, Programming Fundamentals - A backbone for AI and Edge Computing

AI & Edge Computing - Course Description, Relational Model of AI and Edge Computing, ARTIFICIAL INTELLIGENCE(AI) PRINCIPLES AND PRODUCTS, Machine Learning (ML) Fundamentals and Principles, Application of ML in Manufacturing and Production Industries, Diesel Generators with IoT Framework - A Model IoT Architecture, Quick Tour on Edge Devices in IoT, Edge AI and Cloud AI - An Overview, 'TinyML' – A Cutting Edge Field, Case Study on ' Edge AI Practices in Industrial Applications', Introduction to Python, Python Internals, Programming Essentials in python Part I and II, DEMO PROGRAMS IN PYTHON - Beginners Perspective, DEMO PROGRAMS IN PYTHON - Beginners Perspective, Machine Learning Libraries and Functions in Python, House Price Prediction with Sklearn Framework, Working with Data for ML - Demo with Kaggle Data set, Working with Micropython - An Overview, Python in " Deep Learning for Self Driving Cars " - A case study approach

Demos on:

- Demo programs in Python and House price prediction

Unit – II: Python Demos and Case-Studies on Machine Learning (ML) Algorithm Fundamentals, Demonstrating Unsupervised & Reinforcement Machine Learning Algorithms with Python demos, Principles and successful demonstrations of Neural Networks (Text Analytics), Advanced Applications with Deep Learning Networks

MACHINE LEARNING ALGORITHMS ARCHITECTURE, Big Data in the context of Machine Learning, Machine Learning Types & Algorithm Selection Strategy, Bias and Variance - Trade-off, Machine Learning Strategies for Business Improvement – An Overview, Preparing Data for Optimization in Production Manhours, Supervised Machine Learning Algorithm- Principle and types, Regression algorithm, Classification algorithm, Implementation framework of ML algorithms, Implementation framework of ML algorithms, PRINCIPLES OF UNSUPERVISED MACHINE LEARNING ALGORITHM, Clustering algorithm, DBSCAN clustering algorithm, DIMENSIONALITY REDUCTION ALGORITHM – PRINCIPLE & IMPLEMENTATION OF PCA, Linear Discriminant Analysis - A Quantitative Approach, Autonomous vehicle embedded with Dimensionality Reduction Algorithm, REINFORCEMENT MACHINE LEARNING ALGORITHM – WITH A PRACTICE APPROCH IN HVAC SYSTEM, MODEL BASED RL ALGORITHMS – PRINCIPLE AND EXAMPLE WITH DYNA Q ALGORITHM, Paradigm shift in health care diagnosis with reinforcement learning - a review exercise, Model Free Reinforcement learning – exploring policy based methods, DEPLOYMENT OF DEEP Q-LEARNING IN PICK AND PLACE COBOT - An Industrial application of ML, FUNDAMENTALS OF NEURAL NETWORK, DIGIT RECOGNITION USING MLP MODEL – HANDS-ON PRACTICE, GRADIENT DESCENT ALGORITHM- WORKING PRINCIPLE, BACKPROPAGATION ALGORITHM – WORKING PRINCIPLE, Cross-Entropy cost function and its implementation using MLP, Overfitting and Regularization principles with a hands-on approach,

DIGIT RECOGNITION SYSTEM FOR VISUALLY IMPAIRED – CNN BASED ML ALGORITHM, STOCHASTIC GRADIENT DESCENT ALGORITHM PRINCIPLE AND ANALYSIS USING IRIS DATASET, Simulation of Neural Networks - Weka tool based exercise, Strategic deployment of shallow neural network for enhancing agriculture - a review exercise, VANISHING GRADIENT PRINCIPLES AND ITS MEASUREMENTS IN SIGMOID ACTIVATION FUNCTION, Unstable Gradient in Complex networks, Unstable Gradient in Complex networks, Introduction to convolutional neural networks, Introduction to convolutional neural networks, Applications of CNN, Generative Network Principles, Introduction to RNN, Properties and Construction of RNN, Implementation of RNN for NLP, Case-Study on Recommendation Systems

Demos on:

- Bias and Variance, EDA, Classification on Iris dataset using SVM, Salary Prediction, EV Vehicle Purchasing, Lung Cancer Prediction, K-Means Clustering, DBSCAN Clustering, PCA, Reinforcement Learning, Digit Recognition Using MLP, Backpropagation Algorithm, Cross Entropy, Overfitting and Regularization, Digit Recognition for Visually Impaired, Stochastic Gradient Descent, WEKA Simulation, Vanishing Gradient, Unstable Gradient, Pneumonia Detection and NLP

Unit – III: IoT Architecture and Development model of Edge Computing, Software platforms and tools for Edge Computing, Hardware tools and resources for Edge Computing

IoT General Architecture, IoT Architecture with AI, Case-Study Analysis, Issues and Challenges in IOT with Cloud AI, Revised IOT Architecture with Fog AI and Edge AI, Tiny ML working principle, Tiny ML as SaaS model, High Computing Machine based Edge Architecture, Distributed Training, Compression technique, Case Study-1 on flow sensing with totalizer, Case-Study-2 on Water management in public utilities, Software tools and their scope for AI and ML, Additional software requirements for Tiny ML, Example IDE for ML – Colab, Libraries required for ML, Tensor Flow Library – Principles, Keras Library – Principles, Arduino IDE for Edge Computing, Tensorflow Lite – Principles, Example – ML, Example - ML with ANN, Example - Tiny ML AI based Software development methodologies, Quick survey on the hardware resources, Basics of Arduino Nano BLE Board, Programming with Arduino Nano BLE(ANB), Programming with built-in Sensors in ANB, Design framework for Edge computing in ANB, Sinewave prediction model analysis, Demonstration using ANB, Word Detection model using ANB, Person Detection Model using ANB, Magic Wand model using ANB

Demos on:

- Diesel Level Monitoring, Crop Analysis, Edge Impulse, WEKA, Blink, Air Quality Monitoring, Garbage Classification, Gesture Initial Model, Evolution of Software Development Methodologies, Colors Blink, Microphone & IMU (Gesture Recognition), Sine wave prediction, Wake Word and Magic Wand

Unit – IV: ML algorithms and scope for Edge Computing in Electrical Engineering Applications, ML algorithms and scope for Edge Computing in Mechanical Engineering Applications, ML algorithms and scope for Edge Computing in Civil Engineering Applications

Basics of Substation, ANN Architecture for Substations, Load Prediction in Substations - A case Study, Geo-spatial database for power infrastructure, Feature Extraction of substation using Deep Learning- A Case study, Power grid stability and secondary substation model, Estimation of unknown secondary substation profile - A case study, Characterization of substation site features-Practitioner approach, CNN based preliminary siting of substation - A Case Study, Substation Device Diagnosis using unsupervised ML algorithm, CNN based Infrared Fault Image Diagnosis - A Case Study, Impact of ML in O&G Industry - A Review, Seismic Data Processing Techniques, Geomodeling Process, ML in Reservoir Engineering, Optimal Production Engineering in O&G Industry, AI in upstream sector of O&G Industry, Advances in AI Technology for O&G Industry, Fundamentals of Data handling in O&G Industry, SOA of big data for O&G Industry ML for Civil Engineering, Cloud Data collection about the Construction Site, Generic ML modelling framework for Civil Engineering Applications, Deep Learning Techniques in Construction Industry, ML approach for Construction Management, CNN based Planetary Lego Brick, AI in Transport Engineering - A Survey, Road Traffic Prediction - Bayesian Approach, ML for Naval Architecture, AI based Wave Height Forecasting - A Case Study

Demos on:

- Energy Prediction, Solar Energy Power Generation Analysis, Feature Extraction Substation using Deep Learning, Estimating the Power Grid Stability - A Hands on Approach, Practitioner approach, Fault Detection in Power Line System, Diesel Price Prediction, Salt Dome Detection, Reservoir Simulation, Well Bore Testing in Oil and Gas Industry, Stock Price Prediction for Oil and Gas Industry, Concrete Compressive Strength Prediction, IIoT Data Collection for ML Algorithms, Building Crack Detection, Classification of LEGO Bricks, Road Traffic Prediction and Ship Classification

Unit – V: Real-Time Applications of ML - A Structured Approach and Demos, ML algorithms and scope for Edge Computing in Future

Automated Vehicle support using ML, Fraud System Diagnosis using ML, Deep learning based shop floor management, Neural networks based ground water quality distribution analysis, Potential applications of AI in Healthcare – Discussion, Image Classification in IoT Devices - Case Study, Remotely Piloted Aircraft - Case Study, AI Products - A survey, Education Quality updates in Design, Development and Delivery using ML, AI impacts in Education, AI open source software libraries, Computer Vision (Image and Video), Language and Language Reasoning, Speech Recognition, Healthcare and Biology, Ethical Challenges in AI, Economy Implications due to AI, Policies and Strategies for AI

Demos on:

- Email Spam Detection, Bosch Performance Line, Diabetic Retinopathy, Edge Impulse - Flower, Forest Fire, Graduate admission prediction, Car object detection, Language prediction, Speech recognition, Heart disease prediction and L&T Stock data analysis

L&T EduTech

Renewable Energy and Power Evacuation

Unit – I - The Need for Sustainability

Global Warming and Net Zero Emissions, Exhaustion of Fossil Fuels, The Present power scenario, Carbon Sequestration, Mitigation and Neutrality, Global Carbon Footprint, Commitments at COP-26 Glasgow Conference, Environmental, Social and Governance (ESG), Innovation in Architecture and Construction, Consumer Goods and Energy, Innovation in Life Sciences, Transportation and Mobility

Various Forms of Renewable Energy: Geo-Thermal Energy, Tidal Energy, Biomass Energy, Solar Energy, Wind Energy, Hybrid Energy

Unit – II - Solar Power Generation, Challenges and Typical Sizing Calculations with Case Study

Solar Power Generation: Photo Voltaic (PV) Cells – Theory and Principles, Types and Modules, Electrical Performance Characteristics of Photovoltaic Cells, Photo Voltaic Panel Tilt angles and Optimising Energy Capture, Photo Voltaic System – Power System Configurations, Charge Controller and Inverters, Cost and Economics, Statistics and Future Outlook, Concentrated Solar Power (CSP), Determination of PV Module Characteristics using MATLAB Software

Solar Power Challenges and Typical Sizing Calculations: Advantages of Solar Power, Solar Power Challenges and Mitigation, Solar Panel Sizing Calculation, Sizing of Converter for Solar Panel, PV System Standards and Softwares, Demonstration of System Advisor Model (SAM) and PVSyst softwares, Design and Simulation of Grid Connected PV Solar System and Off-grid Connected/Standalone PV Solar System, with Shading effects using PVSyst, SAM Softwares

Solar Power Generation case study: Feasibility of Mega Scale Solar Power Generation in Deserts, Power Export: Generation in African Desert and Export to Europe, Case Study of Morocco Solar Power Generation, Under Sea Power Cables for Evacuation of Power, Case Study of Rajasthan/Gujarat for Mega Solar Parks, Intention of International Solar Alliance

Unit – III - Wind Power Generation, Challenges and Typical Sizing Calculations

Wind Power Generation: History of Wind Power, Different Types of Wind Turbines, Wind Power Plants and Components, Theory and Calculations related to Wind Power, Wind Turbine Sizing, Wind Energy – Global Wind Atlas

Wind Power Generation Challenges and Typical Sizing considerations: Advantages of Wind Power, Challenges for Wind Power, On-shore and Off-shore Technology, Wind Farm Optimized Spacing, Wind Turbine Power Evacuation, Power Evacuation for Wind Farms

Unit - IV - Energy Storage

New Developments in Solar & Wind Technology: Solar Chimney, Thin Film Solar PV Cells, Spherical Solar Cells, Perovskite Solar Cells, Agri Voltaics, Bladeless Wind Power Technology, New Designs of Wind Power Generators under Development

Storage of Reliable Renewable Power: Need for Storage, Electrochemical Storage, Battery Storage, Thermal Energy Storage, Compressed Air Energy Storage, Liquid Air Energy Storage, Pumped Hydro Storage, Mechanical Storage

Types of Batteries, Battery Sizing and Super Capacitors: Battery – Basics and Technology, Specifications and Parameters, Li-Ion Batteries, Battery Charging Principle, Battery Sizing Calculations

Hydrogen as a Storage Medium: Introduction to Green Hydrogen Technology, Generation of Green Hydrogen, Storage and Delivery, Status of Green Hydrogen – World and India

Unit - V - Impact of Renewable Power on Grid and FACTS

Impact of Renewable power on Grid: Renewable Energy Forecasting, Connection of Renewable Power Source to Power Grid, Load Dispatch Management, Harmonic Components in Renewable Power and its ill effects in Grid Integration, Variation in Power Generation and Change in Direction of Flow, Dedicated Green Corridors, Renewable Energy Tariff and Time of Day (TOD) Metering Concept, Power Purchase Agreements (PPA)

Need for Flexible AC Transmission (FACTS): Integration of Renewable in Grid, Typical FACTS Devices, Synchronous Condensers, Switching Devices, Shunt Capacitors, Transformer controlled Reactors, Static VAR Compensators (SVC), Static Synchronous Compensators (STATCOM)

Chip based VLSI design for Industrial Applications

Unit – I: Digital Fundamentals with combinational and Sequential Design of logic circuits

Introduction to Digital Electronics-Number systems: Binary, octal, decimal, and hexadecimal Conversion between number systems-Binary arithmetic operations-Boolean Algebra and Logic Gates Boolean algebra: Laws and theorems-Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR Logic gate truth tables and Boolean expressions-**Combinational Logic Circuits:** Designing combinational circuits -Multiplexers and demultiplexers ,Encoders and decoders ,Adders and subtractors Comparators. **Sequential Logic Circuits:** Introduction to sequential circuits, Flip-flops: SR, D, JK, and T flip-flops, Analysis and design of sequential circuits, Counters: Ripple counters, synchronous counters, State Machines: Introduction to state machines, Mealy and Moore models, State diagrams and state tables, Designing state machines using flip-flop.

Unit – II: Embedded System Design using Embedded C and Micro python Programming

Introduction to IC Technology-Overview of integrated circuit (IC) technology, Classification of ICs: SSI, MSI, LSI, VLSI, Moore's Law and scaling in IC technology, Fabrication process steps: lithography, oxidation, etching, etc. Basics of MOS Transistor, MOS transistor structure and operation, Enhancement-mode and depletion-mode MOS transistors, MOS transistor characteristics: threshold voltage, mobility, capacitances, MOS transistor scaling and channel length modulation, CMOS Inverter CMOS inverter circuit: NMOS and PMOS transistor configuration, Static and dynamic behavior of CMOS inverters, Inverter transfer characteristics and voltage transfer curve, Noise margins and propagation delay analysis, Static and Dynamic Power Dissipation in CMOS Inverter, Power dissipation sources in CMOS inverters: static and dynamic power ,Power consumption calculation: switching power, short-circuit power, leakage power, Power-delay product optimization techniques, Estimation and reduction of power dissipation in CMOS inverters Low-Power Design Techniques, Introduction to low-power design methodologies, Power reduction techniques at the architecture level ,Circuit-level power optimization techniques, Power gating, clock gating, and voltage scaling techniques, CMOS Logic Circuits Design, Designing complex CMOS logic gates: AND, OR, XOR, etc.

Unit – III Analog and Digital Chip Design using Electric VLSI EDA Tool

Basics Stick Diagram and Layout Design Rules for CMOS Design, Design and simulation of PMOS, NMOS Transistor current -voltage characteristics-Design of Schematic and Simulation of CMOS Inverter, Common Source Amplifier, Common Drain Amplifier, Schmitt Trigger Circuit Using Electric VLSI EDA Tool

Design of Schematic and Simulation of CMOS NAND Gate, AND Gate, NOR Gate, XOR Gate, Half Adder, Multiplexer using Electric VLSI EDA Tool

Unit - IV Digital System Design Using VHDL

VHDL Design and Modelling Styles, Object, Data Types, Operators, Logic Operation and Process Statements, If-else, Case, Loop and Subprograms, Design of Half adders, Full Adders, 4-bit Ripple Carry Adder(RCA), Multiplexer, Demultiplexer, Encoder, Decoder, 4-bit Comparator, Barrel Shifter, Binary to BCD Converter, Binary to Grey Code Converter, BCD to 7 Segment Decoder, 4-bit ALU using VHDL in different modelling styles. Design of D Latch, D, SR, JK, T Flip Flop, Shift Register, Counter, FIFO Memory, RAM, Mealy & Moore sequence detector, Vending Machine using VHDL.

Unit – V: VLSI Design and Implementation of embedded applications with ARTIX FPGA board using Vivado

Demonstration of Interfacing FPGA with SPDT, Buzzer, 7 Segment Display, 3 Axis Accelerometer Sensor, Hand Gesture Recognition Sensor, Capacitive Touch Sensor, Ultrasonic Sensor, DC Motor, Servo Motor, VGA Monitor, Monitoring Temperature and Intensity through IoT with FPGA Device.