CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

Three Year Undergraduate B.Sc. Program
Under
Apprenticeship Embedded Degree Programs (AEDPs)

Subject: Industrial Electronics

Course Structure and Syllabus

Semester	Course Code	Paper Title	PAPER	Credit
I	B310101T	Electrical & Electronic Systems	Core Course-I	4
	B310102T	Semiconductor Material and Nano Tech	Core Course-II	4
	B310103T	Digital Electronics	Core Course-III	4
	B310104P	Digital Electronics Lab	Practical	2
	B310105T	An Introduction to Solar Energy	Minor	3
	VOC166	Computer Application	Skill Enhancement Course(SEC)	3
	Z011101	First Aid & Basic Health	Co-curricular Course	2
		Total Credit		**22**
II	B310201T	Python Programming	Core Course-I	4
	B310202T	Internet of Things (IoT)	Core Course-II	4
	B310203T	Microprocessor Systems	Core Course-III	4
	B310204P	Python Programming Lab	Practical	2
	B310205T	Logic for Programming	Minor	3
	VOC112	Disaster Management	Skill Enhancement Course(SEC)	3
	Z021201	Human Values and Environment Studies	Co-curricular Course	2
		Total Credit		**22**
III	B310301T	Microcontroller Systems	Core Course-I	4
	B310302T	Introduction to Data Science	Core Course-II	4
	B310303T	Sensor and Instrumentation	Core Course-III	4
	B310304P	Instrumentation Lab	Practical	2
	B310305T	Data Analysis with Python	Minor	3
	VOC165	Financial literacy	Skill Enhancement Course(SEC)	3
	Z031301	Physical Education and Yoga	Co-curricular Course	2
		Total Credit		**22**
IV	B310401T	Embedded Systems s	Core Course-I	4
	B310402T	IC technology and VLSI Design	Core Course-II	4
	B310403T	Artificial Intelligence	Core Course-III	4

	B310404P	IC technology and VLSI Lab	Practical	2
	B310405T	Opto Electronic Devices	Minor	3
	VOC151	AI And Data Science Professional	Skill Enhancement Course(SEC)	3
	Z010101	Food Nutrition and Hygiene	Co-curricular Course	2
	Total Credit			**22**
V	B310501T	Power Electronics	Core Course-I	4
	B310502T	Employability Skills	Core Course-II	4
	B310503T	Communication Electronics	Core Course-III	4
	B310504P	Communication Electronics Lab	Practical	2
	B310505T	Allied MOOC Course		2
	B310505T	Micro-Sensor Design	Minor	3
	Total Credit			**19**
VI		Apprenticeship		**20**

B.Sc. – Industrial Electronics

The Three-year Full Time **Bachelor of Science in Industrial Electronics** programme aims to develop competent graduates with a strong foundation in electronics, electrical systems, instrumentation, automation, embedded systems, and industrial control technologies. The programme provides theoretical knowledge and practical skills required to design, install, operate, test, troubleshoot, and maintain modern industrial electronic systems. It also fosters problem-solving ability, professional ethics, innovation, entrepreneurship, and lifelong learning, enabling graduates to pursue higher education or successful careers in electronics, automation, manufacturing, instrumentation, and allied industries.

Programme Outcomes (POs)
Upon successful completion of the programme, students will be able to:

PO1. Fundamental Knowledge

- Apply the principles of mathematics, physics, electronics, and computer science to understand and solve industrial electronics problems.

PO2. Electronic Circuit Analysis

- Analyze, design, test, and troubleshoot analog, digital, and power electronic circuits used in industrial applications.

PO3. Instrumentation and Measurement

- Use electronic instruments, sensors, transducers, and measuring equipment to perform testing, calibration, and maintenance activities accurately.

PO4. Industrial Automation

- Understand and apply the concepts of PLCs, microcontrollers, embedded systems, industrial automation, and control systems for industrial processes.

PO5. Practical and Laboratory Skills

- Demonstrate competency in assembling, testing, fault diagnosis, repair, and maintenance of electronic equipment using standard laboratory practices.

PO6. Problem Solving

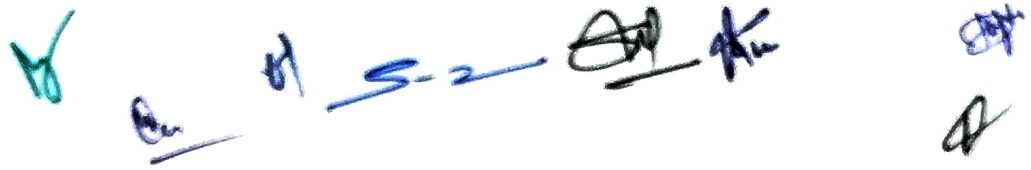
- Identify, analyze, and provide appropriate solutions to technical problems encountered in industrial electronics and automation systems.

PO7. Modern Tools and Software

- Use modern electronic design, simulation, programming, and testing tools for analysis, development, and troubleshooting of electronic systems.

PO8. Employability and Entrepreneurship

Develop the knowledge and skills required for employment in electronics manufacturing, maintenance, automation industries, service organizations, or to establish self-employment and entrepreneurial ventures.



Three Year Undergraduate Programme

INDUSTRIAL ELECTRONICS (AEDP)

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Industrial Electronics (Core)				
Course Code	B310101T	Course Title	Electrical and Electronic Systems		

Course Outcomes (COs)

1) Explain the basics of electricity and electronics.
2) Read and interpret electrical and electronic circuit diagrams.
3) Identify electronic components and select suitable tools.
4) Perform cable assembly, soldering and PCB assembly.
5) Install electrical and electronic sub-systems safely.
6) Test and inspect assembled systems using measuring instruments.

Credits: 4

Unit	Topics
I	**Introduction to Electronics and Basic Electricity** Electronics industry: scope, applications, trends, and challenges, Electrical quantities: Voltage, Current, Resistance, Power, Ohm's Law, AC and DC fundamentals, Series and parallel circuits, Active and passive electronic component Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel.
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's voltage Law (KVL), Node analysis, Star-Delta Conversion. **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits
III	**AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.
IV	**Network Graph Theory:** Equivalent Graph, Incidence matrix, Tie-Set and Cut Set. AC circuit analysis using Network theorems. Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. **Network Theorem: Principal** of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Millman's Theorem, Maximum Power transfer Theorem

Recommended Book:

1)Basic Electrical Engineering – V. K. Mehta & Rohit Mehta (S. Chand)
2)Principles of Electronics – V. K. Mehta & Rohit Mehta (S. Chand)
3)Electronic Devices and Circuit Theory – Robert L. Boylestad & Louis Nashelsky (Pearson)
4)Electronic Devices and Circuits – David A. Bell (Oxford University Press)

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Industrial Electronics (Core)				
Course Code	B310102T	Course Title	Semiconductor Material & Nanotech		

Course Outcomes (COs)

1. Explain the fundamental concepts of semiconductor materials, including intrinsic and extrinsic semiconductors.
2. Describe the electrical, optical, and physical properties of semiconductor materials and nanomaterials.
3. Understand the basic fabrication, characterization, and working principles of semiconductor devices and nanomaterials.
4. Analyze the applications of semiconductor materials and nanotechnology in electronics, communication, energy, and biomedical fields.
5. Demonstrate awareness of recent developments, safety aspects, and future trends in semiconductor technology and nanotechnology.

Credits: 4

Unit	Topics
I	**Fundamentals of Materials Science**: Relative stability of Phase, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Elementary idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposit ion of thin film using sputtering methods (RT and glow discharge). Smart Materials
II	**Semiconductors:** Metal-semiconductor and, Direct and Indirect semiconductors, Variation of energy bands with alloy composition, charge carriers in semiconductors, effective mass, Intrinsic and Extrinsic materials, Diffusion and drift, diffusion length, diffusion and recombination. The Fermi level & Fermi Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration Qualitative and Quantitative analysis, Temperature dependency of carrier concentration, conductivity and mobility, effects of temperature and doping on mobility, high field effects, the hall effects, Invariance of the Fermi level at equilibrium.
III	**Introduction to Nanoscience**: Definition of nanoscience and nanotechnology, Historical development of nanotechnology Nanometer scale and size effects, Bottom-up and Top-down approaches, Classification of nanomaterial's (0D, 1D, 2D, 3D), Types of nanomaterial's, Nanoparticles, Carbon nanotubes (CNTs), Graphene, Quantum dots, Nanowires, Physical, chemical, electrical, and optical properties, Comparison between bulk materials and nanomaterial's
IV	**Applications of Nanotechnology:** **Nanoelectronics**, Medical applications (drug delivery, biosensors), Energy applications (solar cells, batteries, fuel cells), Environmental applications (water purification, pollution control), Nanotechnology in agriculture and food industry.

Recommended Book:

1. "A First Course in Material Science" by Raghvan, McGraw Hill Pub.
2. "Solid State Physics" by S.O.Pillai, New Age Publication.
3. "Electrical Engineering Materials", by A.J. Dekker, PHI Pub.
4. Nano: The Essentials – T. Pradeep (Simple and student-friendly)
5. Nanotechnology: Principles and Practices – S. K. Kulkarni
6. Introduction to Nanotechnology – Charles P. Poole Jr. & Frank J. Owens

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Industrial Electronics (Core)				
Course Code	B310103T	Course Title	Digital Electronics		

Course Outcomes (COs)

1. Convert different type of codes and number systems in computers and communication.
2. Describe switch model used to illustrate building blocks of digital circuits.
3. Use Boolean algebra and Karnaugh maps for reduction of logic expressions and circuits.
4. Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.

Credits: 4

Unit	Topics
I	**Number Systems and Codes:** Binary Number System, Binary-to-decimal Conversion, Decimal-to-binary Conversion, Octal Numbers, Hexadecimal Numbers, The ASCII Code, The Excess-3 Code, The Gray Code, Error Detection and Correction.
II	**Digital principles and logic:** Definitions for Digital Signals, Digital Waveforms, Digital Logic, Digital Computers, Digital Integrated Circuits, Digital IC Signal Levels, Digital Logic, The Basic Gates-NOT, OR, AND, Universal Logic Gates-NOR, NAND, AND- OR-Invert Gates, Positive and Negative Logic
III	**Combinational Logic Circuits:** Boolean Laws and Theorems, Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-sums Method, Product-of-sums Simplification, Simplification by QUINE-Mc-CLUSKY Method
IV	**Arithmetic Circuits:** Binary Addition, Binary Subtraction, Unsigned Binary Numbers, Sign-magnitude Numbers,2's Complement representation, 2's Complement Arithmetic, Arithmetic Building Blocks, The Adder-subtracter, Fast-Adder, Arithmetic Logic Unit, Binary Multiplication and Division **LATCHES** Latches, Flip-flops - SR, JK, D, T, and Master-Slave -Edge triggering Level Triggering Asynchronous Ripple or serial counter Asynchronous Up/Down counter - Synchronous counters Synchronous Up/Down counters, Programmable counters Modulo n counter, Registers, shift registers - Universal shift registers Shift register counters Ring counter Shift counters - Sequence generators. Logic Families

Recommended Book:

1)Electronic Principles - Albert Malvino, David J. Bates, 7th Edition (2016)
2)Basic Electronics - B, Grob, Mitchel E. Schultz, 11th Edition, (2007)
3)Solid state Electronic Devices, B. G. Streetman and S. Banerjee, Pearson Education (2006)
4)Electronic Principles, Albert Malvino, David J. Bates, 7th Edition (2016)
5)Basic Electronics - B, Grob, Mitchel E. Schultz, 11th Edition, (2007)

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Industrial Electronics (Practical)				
Course Code	B310104P	Course Title	Digital Electronics Lab		

Course Outcomes (COs)

1. Convert different type of codes and number systems in computers and communication.
2. Describe switch model used to illustrate building blocks of digital circuits.
3. Use Boolean algebra and Karnaugh maps for reduction of logic expressions and circuits.
4. Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.

Credits: 2

Topics

Lab Experiment List

- Study of AND, OR, NOT, NAND, NOR and XOR gates using IC
- Designing of all the logic gates using NAND gate IC
- Designing of all the logic gates using NOR gate IC
- 4.Verification Of Demorgan's Theorem
- Construction of gates using discrete components Design and Verify Following: -
- Code conversion
- Half adder and Full adder
- Half subtractor and Full subtractor
- Multiplexer and De-Multiplexer
- Encoder and Decoder
- Study of Flip flops
- Shift register
- Ripple counter

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Industrial Electronics (Minor)				
Course Code	B310105T	Course Title	An Introduction to Solar Energy		

Course Outcomes (CO)

1) Explain the basic concepts of solar energy and renewable energy sources.
2) Identify the main components of a solar photovoltaic (PV) system.
3) Describe the working principle of solar PV systems.
4) Perform basic installation and testing of solar energy systems.
5) Identify common faults and carry out basic maintenance of solar PV systems.
6) Follow safety practices while working with solar energy systems.

Credits: 3

Unit	Topics
I	**Introduction to Solar Energy:** **Energy Scenario-**Global energy demand, Conventional energy sources, non-conventional (renewable) energy sources, Need for renewable energy, India's solar energy potential. **Basics of Solar Energy-** The Sun as an energy source, Solar constant, Solar spectrum, Advantages of solar energy, Limitations of solar energy, Applications of solar energy. **Solar Radiation and Measurement:** **Solar Radiation-** Solar radiation fundamentals, Beam radiation, Diffuse radiation, Global radiation **Solar Geometry-** Latitude, Longitude, Declination angle, Hour angle Zenith angle, Solar altitude angle, Azimuth angle **Measurement Instruments-**Pyranometer, Pyrheliometer, Sunshine recorder **Factors Affecting Solar Radiation-**Atmospheric conditions, Clouds, Dust, Seasonal variation
II	**Solar Photovoltaic (PV) Systems:** **Basics of Photovoltaic-** Photovoltaic effect, Semiconductor materials, P-type and N-type semiconductors, PN junction, working principle of a solar cell **Solar Cell Parameters-**Open-circuit voltage (Voc), Short-circuit current (Isc), Maximum power point (MPP), Fill factor, Efficiency **Solar Modules-**Cell, Module, Panel, Array **Types of Solar Cells-**Monocrystalline silicon, Polycrystalline silicon, Thin-film solar cells **Solar Thermal Energy:** **Solar Water Heating-** Flat plate collector, Evacuated tube collector, Solar water heater **Solar Thermal Applications-**Solar cooker, Solar dryer, Solar still, Solar air heater, Solar steam generation.
III	**Solar Thermal Applications** **Main Components-**Solar panels, Mounting structures, Charge controller, Battery, Inverter, DC and AC cables, Junction box, Earthing system, Lightning protection **Types of PV Systems-**Stand-alone systems, Grid-connected systems, Hybrid systems
IV	**Installation, Testing and Maintenance** **Installation-**Site assessment, Panel orientation, Tilt angle, mounting methods, Wiring practices Safety precautions

	Testing-Open-circuit voltage measurement, Short-circuit current measurement, Insulation resistance test, Polarity test **Maintenance**-Cleaning of modules, Battery maintenance, Inspection of cables, Troubleshooting common faults

Recommended Book:

1) G. D. Rai, Non-Conventional Energy Sources.
2) S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage.
3) Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications.
4) Gilbert M. Masters, Renewable and Efficient Electric Power Systems.
5) NPTEL, Introduction to Solar Energy course materials)

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Industrial Electronics (Core)				
Course Code	B310201T	Course Title	Python Programming		

Course Outcomes (COs)

Course outcomes:

1. Learn the syntax and semantics of Python Programming Language.
2. Write Python functions to facilitate code reuse and manipulate strings.
3. Illustrate the process of structuring the data using lists, tuples and dictionaries.
4. Demonstrate the use of built-in functions to navigate the file system.

Credits: 4

Unit	Topics
I	**Basics of Python Programming** Features of Python, variables and identifiers, operators and expressions. Decision control Statements: Selection/Conditional branching statements, basic loop structures/iterative Statements, nested loops, break, continue, and pass Statements. Functions and Modules: function definition, function call, more on defining functions, recursive functions, modules.
II	**Data Structure Strings** Introduction, built-in string methods and functions, slice operation, String Module. Regular Expressions. Lists: Introduction, nested list, cloning lists, basic list operations, list methods. Functional programming.
III	**Tuples** Introduction, basic tuple operations, tuple assignment, tuples for returning multiple values, nested tuple, mutable items, uses. Sets: Introduction, Set operations. Dictionaries: Basic operations, sorting items, looping over dictionary, nested dictionaries, dictionary methods.
IV	**Files and Exceptions** Reading and writing files, pickling, handling exceptions. Built-in and user-defined exceptions. OOPS Concepts: Introduction to classes and objects, class method and static method, and private data members, Inheritance, Operator Overloading.

Recommended Book:

1. Reema Thareja, Pythan Programming using problem solving approach, Oxford University press.
2. Allen Downey, 'Think Python: How to Think Like a Computer Scientist', O'Reilly publications, 2nd Edition, 2015.
3. Albert Lukaszweski, Mysql for Python PACKT publishers
4. Mark Lutz, 'Learning Python', O'Reilly Publications.
5. Stevrt venit and Elizabeth Drake,Prelude to Programming: Concepts and Design', 6th Edition (2015).
6. Mark J Guzdial, 'Introduction to Computing and programming in Python, 3rd Edition, Pearson.

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Industrial Electronics (Core)				
Course Code	B310202T	Course Title	Internet of Things (IoT)		

Course outcomes:

1. Incorporate the best practices learnt to identify the attacks and mitigate the same.
2. Adopt the right security techniques and protocols during the design of IoT products.
3. Assimilate and apply the skills learnt on ciphers and block chains when appropriate.
4. Describe the essential components of IoT.
5. Find appropriate security/privacy solutions for IoT.

Credits: 4

Unit	Topics
I	**Introduction to IoT:** Introduction to Internet of Things (IoT), Evolution and History of IoT, Characteristics and Features of IoT, IoT Architecture, Physical and Logical Design of IoT, IoT Ecosystem Machine-to-Machine (M2M) Communication, IoT Enabling Technologies, Applications of IoT
II	**IoT Devices and Sensors:** Sensors and Actuators, Types of Sensors, Temperature Sensor, Humidity Sensor, Light Sensor, Motion Sensor (PIR), Gas Sensor, Ultrasonic Sensor, Embedded Systems, Arduino UNO, ESP8266 and ESP32 (Introduction), Raspberry Pi (Introduction), Signal Conditioning, Interfacing Sensors with Microcontrollers
III	**IoT Communication and Networking:** IoT Communication Models, Wired and Wireless Communication, TCP/IP Basics, IPv6 Wi-Fi, Bluetooth, ZigBee, RFID, NFC, LoRaWAN (Introduction), MQTT Protocol CoAP Protocol, HTTP and REST API, IoT Security Basics
IV	**IoT Cloud and Data Management:** Cloud Computing Basics, IoT Cloud Platforms, Data Collection and Storage, Real-Time Monitoring, Data Visualization, Mobile Applications for IoT, IoT Dashboards, Edge Computing (Introduction), Data Analytics Basics, IoT Security and Privacy Issues

Recommended Book:

1.Internet of Things: A Hands-On Approach – Arshdeep Bahga & Vijay Madisetti
2.Internet of Things – Raj Kamal
3. Learning Internet of Things – Peter Waher
4.Designing the Internet of Things – Adrian McEwen & Hakim Cassimally
5.Getting Started with Arduino – Massimo Banzi

Programme / Class	Diploma	Year	B.Sc. I	Semester-II
Subject	Industrial Electronics			
Course Code	B310203T	Course Title		Microprocessor System (Core)

Course outcomes:

1.Understand the basic blocks of microcomputers i.e. CPU,Memory,I/O and architecture of microprocessor and microcontroller
2. Apply knowledge and demonstrate proficiency of designing hardware interface for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
3. Derive specifications of a system based on the requirements of the application and select the appropriate microprocessor.

Credits: 4

Unit	Topics
I	**Introduction to Microprocessor:** Introduction, Applications, Basic Block Diagram, Speed, Word Size, Memory Capacity, Classification of Microprocessors (Mention Different Microprocessors being used). **8085 Microprocessor:** Main Features, Architecture, Block Diagram, CPU, ALU, Registers, Flags, Stack Pointer, Program Counter, Data and Address Buses, Control Signals, Pin-Out Diagram and Pin Description.
II	**8085 Instruction and Programming:** Operation Code, Operand and Mnemonics, Instruction Classification, Addressing Modes, Instruction Format, Instructions Set, Data Transfer, Arithmetic, Increment, Decrement, Logical, Branch and Machine Control Instructions, Assembly Language Programming Examples, Stack Operations, Subroutines and Delay Loops Call and Return Operations, Use of Counters, Timing and Control Circuitry, Timing Diagram, Instruction Cycle, Machine Cycle, T (Timing)-States, Time Delay.
III	**Interrupts:** Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts, Latency Time and Response Time.
IV	**Interfacing:** Basic Interfacing Concepts, Memory Mapped I/O and I/O Mapped I/O and Isolated I/O Structure, Partial/Full Memory Decoding, Interfacing of Programmable Peripheral Interface (PPI) Chip (8255), Address Allocation Technique and Decoding, Interfacing of I/O Devices (LEDs and Toggle-Switches as Examples).

Recommended Book:

1. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram.
2. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai.
3. Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, PHI.
4. Mathur and Panda, Microprocessors and Microcontrollers, PHI.
5. Shah, 8051 Microcontrollers: MCS 51 Family and its Variants, Oxford.
6. Ayala and Gadre, The 8051 Microcontroller and Embedded System using Assembly and C, Cengage.
7. Mazidi, Mazidi and McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C,Pearson.

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Industrial Electronics (Practical)				
Course Code	B310204P	Course Title	Python Programming		

Course Outcomes (COs)

1. Understand the fundamentals of Python programming, including syntax, data types, operators, and control structures.
2. Develop Python programs using functions, modules, strings, lists, tuples, dictionaries, and file handling.
3. Apply object-oriented programming concepts such as classes, objects, inheritance, and polymorphism to solve programming problems.
4. Design and implement Python programs for data processing, problem-solving, and basic applications using standard libraries.
5. Debug, test, and document Python programs while following good programming practices and coding standards.

Credits: 2

Topics

Lab Experiment List

- Write a Python program to display "Hello, World!"
- Write a program to perform basic arithmetic operations.
- Write a program to find the largest of three numbers.
- Write a program to check whether a number is even or odd.
- Write a program to check whether a year is a leap year.
- Write a program to calculate the factorial of a number.
- Write a program to generate the Fibonacci series.
- Write a program to check whether a number is prime.
- Write a program to reverse a string and check for a palindrome.
- Write a program to perform operations on lists (add, delete, search, and sort).
- Write a program to demonstrate tuple and dictionary operations.
- Write a program using functions to perform addition, subtraction, multiplication, and division.
- Write a program to demonstrate recursive functions.
- Write a program to read from and write to a text file.

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Industrial Electronics (Minor)				
Course Code	B310205T	Course Title	Logic for Programming		

Course Outcomes (COs)

1. Understand the fundamentals of programming logic.
2. Develop problem-solving skills using algorithms and flowcharts.
3. Learn decision-making and looping concepts.
4. Apply logical thinking to program design.
5. Build a foundation for learning programming languages such as Python and C.

Credits: 3

Unit	Topics
I	**Introduction to Programming Logic:** Problem-solving concepts, Algorithm: Definition and characteristics, Flowcharts: Symbols and drawing techniques, Pseudo code, Programming languages: Low-level and High-level Programming process: Problem analysis, coding, testing, and debugging
II	**Variables, Data Types and Operators:** Constants and variables, Data types (Integer, Float, Character, Boolean, String), Input and output concepts, Arithmetic operators, Relational operators, Logical operators, Assignment operators, Operator precedence
III	**Decision Making and Looping:** Conditional statements if, if–else, Nested if, Switch-case (concept), Looping statements for loop, while loop, do-while (concept), Break and continue statements
IV	**Programming Concepts and Applications:** Modular programming, Basic debugging techniques, Error types (Syntax, Runtime, Logical), Introduction to Object-Oriented Programming (OOP), Real-life programming examples, Problem-solving using algorithms and flowcharts

Recommended Book:

1. Programming Logic and Design – Joyce Farrell
2.How to Solve It by Computer – R. G. Dromey
3.Computer Fundamentals and Programming in C – Reema Thareja
4.Programming in ANSI C – E. Balagurusamy
5.Problem Solving and Program Design in C – Jeri R. Hanly & Elliot B. Koffman

Programme / Class	Certificate	Year	B.Sc.II	Semester	III
Subject	Industrial Electronics (Core)				
Course Code	B310301T	Course Title	Microcontroller System		

Course Outcomes (COs)

1. Explain the architecture, organization, and working principles of microcontroller systems.
2. Understand the instruction set, programming concepts, and memory organization of a microcontroller.
3. Develop and test simple microcontroller programs for input/output interfacing and peripheral control.
4. Interface basic devices such as LEDs, switches, displays, sensors, and motors with a microcontroller to implement embedded applications.
5. Analyze and develop simple embedded system applications using microcontrollers for industrial and automation systems.

Credits: 4

Unit	Topics
I	**Introduction to Microcontrollers:** Introduction to Microprocessors and Microcontrollers, Difference between Microprocessor and Microcontroller, Applications of Microcontrollers, Architecture of **8051 Microcontroller** Block Diagram of 8051, Pin Configuration, Memory Organization (ROM and RAM), Special Function Registers (SFRs)
II	**Programming of 8051 Microcontroller:** Instruction Set of 8051, Addressing Modes, Assembly Language Programming, Data Transfer Instructions, Arithmetic and Logical Instructions, Branching Instructions, Simple Programming Examples
III	**Timers, Counters and Interrupts:** Timer and Counter Concepts, Timer Modes of 8051, Programming Timers, Interrupt Structure, Interrupt Programming, Serial Communication (UART), Introduction to Baud Rate
IV	**Interfacing Techniques-** LED Interfacing, Seven-Segment Display Interfacing, LCD Interfacing, Switch and Keypad Interfacing, Relay Interfacing, DC Motor Interfacing, Sensor Interfacing (Basic) **Applications of Microcontrollers-** Embedded Systems Overview, Arduino (Introduction), IoT using Microcontrollers (Basic) Home Automation, Industrial Automation, Traffic Light Controller, Temperature Monitoring System, Future Trends in Embedded Systems

Recommended Book:

1. The 8051 Microcontroller and Embedded Systems – Muhammad Ali Mazidi, Janice Gillispie Mazidi & Rolin D. McKinlay
2. The 8051 Microcontroller: Architecture, Programming and Applications – K. J. Ayala
3. Microcontrollers: Theory and Applications – Ajay V. Deshmukh
4. Microcontroller and Embedded Systems – S. B. Patil

Programme / Class	Certificate	Year	B.Sc.II	Semester	III
Subject	Industrial Electronics (Core)				
Course Code	B310302T	Course Title	Introduction to Data Science		

Course Outcomes (COs)

1. Explain the fundamental concepts, scope, and applications of data science.
2. Understand the data science lifecycle, data collection methods, and basic data preprocessing techniques.
3. Apply basic statistical and visualization techniques to analyze and interpret data.
4. Use Python and common data science libraries to perform simple data analysis and visualization tasks.
5. Demonstrate an understanding of ethical issues, data privacy, and real-world applications of data science in business, healthcare, education, and engineering.

Credits: 4

Unit	Topics
I	**Introduction to Data Science**: Definition and importance of Data Science, Evolution of Data Science, Data Science process Applications in healthcare, agriculture, finance, business, education, and manufacturing, Data Scientist roles and responsibilities, Data Science lifecycle, Data Mining, Data Warehousing Artificial Intelligence, Machine Learning, and Data Science relationship
II	**Data Collection and Data Preparation**: Types of data -Structured data, Semi-structured data, Unstructured data, Data sources, Data acquisition, Data cleaning, Data preprocessing, Missing value handling, Outlier detection, Data transformation, Data normalization
III	**Statistics for Data Science:** Measures of central tendency-Mean, Median Mode, Measures of dispersion -Range, Variance Standard deviation, Probability basics, Sampling techniques, Correlation, Covariance, Introduction to hypothesis testing
IV	**Python for Data Science:** Introduction to Python, Variables and data types, Operators, Control statements, Functions, Lists Tuples, Dictionaries, NumPys, Pandas, Data Frames, Reading CSV and Excel files.

Recommended Book:

1. Introduction to Data Science – Amit Kumar Das.
2. Doing Data Science – Rachel Schutt & Cathy O'Neil.
3. Data Science for Business – Foster Provost & Tom Fawcett.

Programme / Class	Certificate	Year	B.Sc.II	Semester	III
Subject	Industrial Electronics (Core)				
Course Code	B310303T	Course Title	Sensor & Instrumentation		

Course Outcomes (COs)

1. Understand the basic concepts, standards, and units of measurement used in instrumentation systems...
2. Explain the static and dynamic characteristics of measurement systems and analyze their performance. .
3. Apply basic statistical and visualization techniques to analyze and interpret data.
4. Use Python and common data science libraries to perform simple data analysis and visualization tasks.
5. Demonstrate an understanding of ethical issues, data privacy, and real-world applications of data science in business, healthcare, education, and engineering.

Credits: 4

Unit	Topics
I	**Introduction of Measurement** Precision & accuracy, Characteristics of Instruments, Measurement of frequency, phase, time – interval, impedance, power measurement, energy measurement and measurement of distortion, Errors in Measurement **Electrical Transducers:** Fundamental Concept & Transducers Classification Resistance, Capacitance, Inductance, Piezoelectric, Thermoelectric, Techo generator, Optical & Digital Transducers
II	**Measuring Instruments-** Basic galvanometer, conversion to voltmeter, ammeter and ohmmeter,Multimeter , Measurement of R, L, C Using Bridge, Voltage, Current, Energy, Frequency/Time power, power factor, working principle and procedure of operation of Digital Voltmeter, Digital Multimeters, Digital Frequency Meter, Q-Meter, Digital Storage Oscilloscope. Spectrum Analyzer, Logic Analyzer, recorders-Galvanometer recorders, Strip recorder, X-Y recorder **Measurement of Non – Electrical Quantities** Measurement of Displacement, Velocity, Acceleration, Force, Torque, Strain, Speed& Sound, Temperature, Pressure, Flow, Humidity, Thickness
III	**Sensors:** Introduction to Sensors and Transducers, Classification of Sensors, Resistive Sensors Capacitive Sensors, Inductive Sensors, Piezoelectric Sensors, Hall Effect Sensor, Optical Sensors, Smart Sensors (Introduction)
IV	**Industrial Instrumentation and Applications:** Process Control Basics, Industrial Instrumentation, PLC (Introduction), SCADA (Introduction) IoT-Based Sensor Systems, Biomedical Sensors (Introduction) Applications in Automation, Healthcare, Agriculture, and Smart Industries

Recommended Book:

1. "Measurement, Instrumentation and Sensors Handbook" by J. G. Webster, CRC Press.
2. "Digital Measurement Techniques" by T. S. Rathore, Narosa Publishing House, New Delhi.
3. Sensors and Transducers – D. Patranabis
4. Mechanical and Industrial Measurements – R. K. Jain

Programme / Class	Certificate	Year	B.Sc.II	Semester	III
Subject	Industrial Electronics (Practical)				
Course Code	B310304P	Course Title	Instrumentation Lab		

Course Outcomes (COs)

1. Identify and operate basic electrical and electronic measuring instruments safely and accurately.
2. Perform calibration and measurement experiments using standard instrumentation techniques.
3. Measure physical parameters such as temperature, displacement, light intensity, pressure, and force using appropriate sensors and transducers.
4. Analyze the characteristics and performance of various sensors through experimental observations and data interpretation.
5. Design and implement simple sensor-based measurement and monitoring systems for basic industrial and automation applications.

Credits: 2

Topics

Lab Experiment List

- Study of Basic Electrical Measuring Instruments (Voltmeter, Ammeter, and Multimeter).
- Calibration of a Voltmeter using a standard reference source.
- Calibration of an Ammeter using a standard ammeter.
- Measurement of Resistance using a Wheatstone Bridge.
- Study and Characteristics of RTD (Resistance Temperature Detector).
- Study and Characteristics of a Thermistor.
- Temperature Measurement using a Thermocouple.
- Study of LVDT for displacement measurement.
- Characteristics of a Strain Gauge for force/weight measurement.
- Study of Hall Effect Sensor for magnetic field detection.
- Characteristics of an LDR (Light Dependent Resistor) for light intensity measurement.
- Study of Capacitive and Inductive Proximity Sensors.
- Measurement of Pressure using a pressure sensor (demonstration/basic setup).
- Interfacing a Temperature Sensor (LM35 or DHT11) with a microcontroller.

Programme / Class	Certificate	Year	B.Sc.II	Semester	III
Subject	Industrial Electronics (Minor)				
Course Code	B310305T	Course Title	Data Analysis with Python		

Course Outcomes (COs)

1. Understand the fundamentals of Python programming and use Python libraries for data analysis.
2. Import, clean, organize, and preprocess data using **NumPy** and **Pandas**.
3. Perform descriptive statistical analysis and summarize datasets using Python.
4. Create meaningful data visualizations using **Matplotlib** and **Seaborn** to interpret trends and patterns.
5. Apply basic data analysis techniques to solve real-world problems and communicate findings effectively through charts and reports.

Credits: 3

Unit	Topics
I	**Introduction to Python-** Introduction to Python and its applications, Installing Python and Jupyter Notebook, Variables, Data Types and Operators, Input and Output Functions, Conditional Statements (if, if-else), Loops (for, while), Functions (Basic
II	**Python Data Structures-** Strings, Lists, Tuples, Dictionaries, Sets, Basic File Handling, Exception Handling (Introduction)
III	**Data Processing and Visualization –** Data Cleaning, Handling Missing Values, Sorting and Filtering Data, Basic Statistical Functions, Introduction to Matplotlib, Line Chart, Bar Chart, Pie Chart, Histogram
IV	**Basic Data Analysis Applications-** Descriptive Statistics, Data Summarization, Simple Data Analysis Projects, Case Studies using Python, Mini Project and Report Preparation

Recommended Book:

1. "Measurement, Instrumentation and Sensors Handbook" by J. G. Webster, CRC Press.
2. "Digital Measurement Techniques" by T. S. Rathore, Narosa Publishing House, New Delhi.
3. Sensors and Transducers – D. Patranabis
4. Mechanical and Industrial Measurements – R. K. Jain

Programme / Class	Certificate	Year	B.Sc.II	Semester	IV
Subject	Industrial Electronics (Core)				
Course Code	B310401T	Course Title	Embedded Systems		

Course Outcomes (CO)

1. Understand the architecture and basic concepts of embedded systems and distinguish them from general-purpose computing systems...
2. Analyze and design embedded system hardware components including microcontrollers, memory, and peripheral interfaces.
3. Develop embedded software using programming languages like C and assembly for microcontrollers and real-time operating systems (RTOS).
4. Interface various sensors, actuators, and communication modules with embedded systems for real-world applications.

Credits: 4

Unit	Topics
I	**Hardware Considerations**: Introduction: Overview, design metrics, processor technology, design technology. Custom single purpose processors- introduction, RT-level combinational & sequential components, custom single purpose processor design, Optimizing program, FSMD, data path & FSM. General purpose processors and ASIP's: Basic architecture and operation of general purpose processors, programmer's view, development environment - ASIP's – microcontrollers, DSP and less general ASIP environments.
II	**Standard Processor Peripherals:** Timers, counters and watchdog timers, applications, UART, PWM application, LCD controller, keypad controllers, stepper motor control, ADC and DAC. Memory: Different types of ROM & RAMS, cache system design
III	**Interfacing**: introduction to interfacing, communication basics, basic protocol concepts, interrupts and DMA, arbitration, multilevel bus architectures, communication - serial parallel and wireless protocols, I 2C, CAN, USB, FireWire, parallel and wireless protocols
IV	**Introduction to RTOS:** Tasks, states, data – semaphores and shared data. More operating system services – message queues, mail boxes and pipes, timer function, events, memory management, interrupt Basic design using RTOS: Principles, an example, encapsulating semaphores and queues, hard real time scheduling considerations, saving memory, space and power. Embedded software development tools: Host and target machines, linkers/locators for embedded software.

Recommended Book:

1. "Embedded system Design" by Frank Vahid and Tony Givargis, John Wiley.
2. "An Embedded Software Primer" by David E.Simon, Pearson Education.
3. "Real Time System Design and Analysis" by Phillip A Laplante, PHI Pub.

Programme / Class	Certificate	Year	B.Sc.II	Semester	IV
Subject	Industrial Electronics (Core)				
Course Code	B310402T	Course Title	IC technology and VLSI Design		

Course Outcomes (CO)

1. Explain the fundamentals of Integrated Circuit (IC) technology, semiconductor fabrication processes, and cleanroom practices.
2. Describe the MOSFET fabrication process, CMOS technology, and the basic concepts of VLSI design.
3. Analyze CMOS logic gates, layout design rules, scaling techniques, and performance parameters of VLSI circuits.
4. Design and verify simple combinational and sequential digital circuits using VLSI design concepts and Electronic Design Automation (EDA) tools.

Credits: 4

Unit	Topics
I	**Crystal Growth & Wafer Characterization**: Electronic Grade Silicon, CZ Crystal Growing, Silicon Shaping, Processing Consideration. Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators. Growth Mechanism, Oxide Properties, Oxidation Induced Defects. Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography. Feature Size Control and Anisotropic, Etch Mechanisms, Reactive Plasma Etching Techniques and Equipment
II	**Diffusion and Metallization:** Models of Diffusion in Solids, Fick's One Dimensional Diffusion Equations, Atomic Diffusion Mechanisms. Range Theory, Implantation Equipment, Annealing. Metallization Applications, Metallization Choice, Physical Vapour Deposition, Patterning, Bipolar IC Technology
III	**Introduction to MOS:** MOS, CMOS IC Technology, Metal Gate, Poly Silicon Gate, P-Channel, N- Channel Devices, Enhancement Mode and Depletion Mode Devices and their Characteristics
IV	**VLSI design Introduction:** Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design. Manufacturing CMOS Integrated Circuits, Design Rules, IC Layout, Scaling factors, advantages of scaling, limitations to scaling, scaling of wires and interconnections.

Recommended Book:

1. "VLSI Technology" by S. M. Sze,Mcgraw Hill Pub.
2. "Solid State Electronic Devices" by Ben G. Streetman, PHI Pub.
3. "VLSI Design" by K.Lal Kishore and V. Prabhakarl, I.K.International Pub.
4. "Physics and Technology of Semiconductor Devices" by A. S. Grove, John Wiley and Sons Pub.
5. "Basic VLSI design" by Douglas A Pucknell and Kamran Eshraghian, PHI Pub.
6. "CMOS VLSI design" by Neil H E Weste and David Harris, Pearson Pub.

Programme / Class	Certificate	Year	B.Sc.II	Semester	IV
Subject	Industrial Electronics (Core)				
Course Code	B310403T	Course Title	Artificial Intelligence (AI)		

Course Outcomes (CO)

1. Understand the basic concepts, history, and applications of Artificial Intelligence.
2. Explain different AI problem-solving methods, search algorithms, and knowledge representation techniques.
3. Apply machine learning fundamentals to classify, predict, and analyze data.
4. Develop simple AI programs using Python and AI libraries for real-world applications.
5. Understand the basics of neural networks, deep learning, natural language processing (NLP), and computer vision.
6. Evaluate AI solutions by considering ethical issues, bias, privacy, and societal impact.

Credits: 4

Unit	Topics
I	Introduction to Artificial Intelligence. Natural and artificial intelligence. Role of representation of knowledge, Description matching and goal reduction, exploiting natural constraints in problem solving, Exploiting alternative paths, best paths.
II	Reasoning, Logic and Theorem proving: Deductive and inductive reasoning. Heuristic methods, proof by resolutions and constraint propagation, problem solving par diagrams.
III	Knowledge replacement: First order predicate calculus, Skolemlsation, Resolution principle, Unification nementic networks, frame, system value inheritance, introduction to prolog, Introduction to expert systems, application of expert system and various shells.
IV	Design principles of pattern recognition system, statistical pattern recognition, Parameter estimation methods-Principal Component Analysis (PCA) and Linear discriminant analysis (LDA), Classification Techniques, Nearest Neighbor(NN) Rule, Bayes Classifier, Support Vector Machine (SVM

Recommended Book

1 "Artificial Intelligence" by Elaine Rich and Kelvin Knight,TMH Pub.
2. "Introduction to Artificial Intellegence" by E charniak and D McDermott,Pearson Pub.
3. "Artificial Intellegence and expert systems" byDan W Patterson,PHI Pub.
4. "Artificial Intellegence –A Modern Approach" by Stuart Russell and Peter Norvig,Pearson Education

Programme / Class	Certificate	Year	B.Sc.II	Semester	IV
Subject	Industrial Electronics (Practical)				
Course Code	B310404P	Course Title	IC technology and VLSI Lab		

Course Outcomes (COs)

1. Identify and use basic ICs, digital logic gates, and VLSI design tools safely in laboratory experiments.
2. Perform experiments on combinational and sequential logic circuits using standard ICs.
3. Simulate and verify digital circuits using VLSI/CAD software.
4. Design, implement, and test simple VLSI-based digital circuits and analyze their performance.
5. Demonstrate teamwork, technical documentation, and troubleshooting skills while conducting IC and VLSI laboratory experiments.

Credits: 2

Topics

Lab Experiment List

- Study of basic Digital ICs (TTL and CMOS ICs).
- Verification of basic logic gates using ICs (AND, OR, NOT, NAND, NOR, XOR, XNOR).
- Design and implementation of combinational logic circuits using logic gate ICs.
- Verification of Half Adder and Full Adder using ICs.
- Verification of Half Subtractor and Full Subtractor using ICs.
- Design and testing of Multiplexer (MUX) and Demultiplexer (DEMUX) circuits.
- Verification of Encoder and Decoder ICs.
- Study and implementation of Flip-Flops (SR, JK, D, T).
- Design and testing of Shift Registers using ICs.
- Design and verification of Synchronous and Asynchronous Counters.
- Introduction to VLSI design flow and CAD tools.
- Design and simulation of CMOS Inverter using VLSI software.
- Design and simulation of basic CMOS logic gates (NAND, NOR).

Programme / Class	Certificate	Year	B.Sc.II	Semester	IV
Subject	Industrial Electronics (Minor)				
Course Code	B310405T	Course Title	Opto Electronic Devices		

Course Outcomes (COs)

1. Understand the basic principles of optoelectronics and the interaction of light with semiconductor materials.
2. Analyze the working and characteristics of key optoelectronic devices such as LEDs, laser diodes, photodiodes, and phototransistors.
3. Evaluate the performance parameters of optoelectronic devices including quantum efficiency, response time, and spectral sensitivity.
4. Explain the design and operation of optical detectors, optical modulators, and optical sensors

Credits: 3

Unit	Topics
I	**Introduction:** Historical developments, Optical fiber communication system, Principle of optical communication, Advantages of optical fiber communication, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Cylindrical fiber. Structure and types of optical cable: Structure of optical fibers, Single and multimode fibers, Step index and graded index optical fiber.
II	**Transmission Characteristics of Optical Fibers:** Mid-infrared and Far-infrared transmission, Inter-modal and Intra-modal dispersion, Overall fiber dispersion, Polarization
III	**Losses in optical fibers**: Attenuation, Material absorption losses, Linear scattering losses, Non-linear scattering losses and Fiber bends loss and Joint loss. **Preparation methods of optical fibers**: Liquid phase (melting) and Vapour phase deposition techniques
IV	**Optical Fiber Connection:** Joints, Fiber alignment, Splices, Connectors, Couplers. **Optical sources**: Absorption and emission of radiation, Einstein's relation, Population inversion, Optical emission from semiconductors, Semiconductor LASER, LED power and efficiency characteristics. Optical transmitter and receive

Recommended Book:

1"Optical Electronics" by A. Yariv, HRW Pub.
2"Optoelectronics: An introduction" by J.Wilson and J.F.B.Hawkes, PHI Pub.
3"Optical Fiber Communication" by Gerd Keiser, TMH Pub.
4"Optical Fiber Communication" by A. Selvarajan S. Kar and T Srinivas, TMH.

Programme / Class	Certificate	Year	B.Sc.III	Semester	V
Subject	Industrial Electronics (Core)				
Course Code	B310501T	Course Title	Power Electronics		

Course Outcomes (CO)

1. Explain the operating principles, characteristics, and applications of power semiconductor devices such as SCR, TRIAC, GTO, MOSFET, and IGBT.
2. Analyze and design thyristor triggering circuits, commutation techniques, and protection methods for reliable power electronic systems.
3. Analyze the operation and performance of AC–DC converters, DC–DC choppers, and controlled rectifiers used in power conversion.
4. Evaluate the working of DC–AC inverters, AC voltage controllers, cycloconverters, and PWM techniques for industrial applications.
5. Apply power electronic converters in practical systems such as motor drives, SMPS, UPS, battery chargers, and renewable energy applications while considering efficiency, control, and protection

Credits: 4

Unit	Topics
I	**Power Semiconductor Devices-** Introduction to Power Electronics, Characteristics of power semiconductor devices, Power diode SCR (Silicon Controlled Rectifier), TRIAC, DIAC, GTO (Gate Turn-Off Thyristor) Power MOSFET, IGBT, Device ratings, protection, and applications
II	**Thyristor Triggering and Commutation-** SCR triggering methods, Gate triggering circuits, UJT triggering circuit, Commutation techniques, Natural commutation, Forced commutation, Protection of SCR, dv/dt and di/dt protection, Snubber circuits
III	**AC–DC and DC–DC Converters-** Single-phase controlled rectifiers, Three-phase controlled rectifiers, Choppers, Step-up (Boost) chopper, Step-down (Buck) chopper, Chopper control techniques, Performance analysis **DC–AC and AC–AC Converters-** Inverters, Voltage Source Inverter (VSI), Current Source Inverter (CSI), PWM techniques Cycloconverters, AC voltage controllers, Applications of converters
IV	**Industrial Applications –** Switched Mode Power Supply (SMPS), UPS (Uninterruptible Power Supply), Battery charger Variable-speed DC motor drives, AC motor drives, Electric heating, Induction heating, Power electronics applications in renewable energy systems

Recommended Book

1. Power Electronics – P. S. Bimbhra
2. Power Electronics: Circuits, Devices and Applications – Muhammad H. Rashid
3. Power Electronics – P. C. Sen
4. Power Electronics – M. D. Singh & K. B. Khanchandani
5. Thyristor Engineering – B. W. Williams

Programme / Class	Certificate	Year	B.Sc.III	Semester	V
Subject	Industrial Electronics (Core)				
Course Code	B310502T	Course Title	Employability Skills		

Course Outcomes (CO)

1. Demonstrate effective verbal, written, and interpersonal communication skills for academic and professional environments.
2. Apply digital literacy skills by using computers, office productivity tools, the internet, email, and online collaboration platforms safely and effectively.
3. Exhibit professional ethics, teamwork, leadership, time management, problem-solving, and critical thinking skills required in the workplace.
4. Prepare for employment through resume writing, interview skills, career planning, customer service, and entrepreneurship awareness.
5. Develop lifelong learning habits, adaptability, financial awareness, and workplace professionalism to enhance employability and career growth

Credits: 4

Unit	Topics
I	**Communication Skills-** Fundamentals of communication, Verbal and non-verbal communication, Listening, speaking, reading, and writing (LSRW), Business communication, Presentation and public speaking, Email and telephone etiquette, Group discussion and interview skills
II	**Professional Skills and Digital Literacy-** Computer fundamentals, MS Word, Excel, and PowerPoint, Internet, email, and cloud applications, Cyber safety and digital security, Online collaboration tools, Digital documentation and file management
III	**Personality Development and Workplace Ethics-** Self-awareness and self-management, Positive attitude and confidence building, Time and stress management, Teamwork and leadership, Workplace ethics and professionalism, Constitutional values and environmental awareness
IV	**Career Development and Entrepreneurship –** Resume/CV writing, Job search techniques, Interview preparation, Career planning, Entrepreneurship and start up basics, financial literacy, Government schemes for entrepreneurship

Recommended Book

1.Employability Skills – Directorate General of Training (DGT)
2.Soft Skills – S. P. Dhanavel
3.Personality Development and Soft Skills – Barun K. Mitra
4.Communication Skills – Sanjay Kumar & Pushp Lata
5.Business Communication – C. S. Rayudu

Programme / Class	Certificate	Year	B.Sc.III	Semester	V
Subject	Industrial Electronics (Core)				
Course Code	B310503T	Course Title	Communication Electronics		

Course Outcomes (CO)

1. Explain the basic concepts and principles of analog and digital communication systems.
2. Describe and analyze various analog modulation schemes such as AM, FM, and PM, and their demodulation methods.
3. Design basic circuits used in communication systems including oscillators, mixers, modulators, and demodulators.
4. Understand the impact of noise in communication systems and analyze system performance under noisy conditions

Credits: 4

Unit	Topics
I	**AM GENERATION & TRANSMISSION** -Need for modulation Amplitude modulation Frequency Spectrum of AM Wave - Modulation Index Power relations in the AM Wave AM generation AM Transmitter. - Forms of Amplitude Modulation Evolution of SSB, Balanced modulator Methods of SSB Generation, Vestigial side band Transmission. **Analog Pulse Modulation:** Channel Capacity, Sampling Theorem, Basic Principles of PAM, PWM and PPM, Modulation and Detection Technique for PAM only, Multiplexing, TDM and FDM.
II	**FM GENERATION & TRANSMISSION** Frequency Modulation - Frequency Spectrum of the FM Wave Modulation Index Effect of Noise Adjacent & Co-Channel Interference Wide Band & Narrow Band FM-FM Generation.
III	**AM & FM RECEPTION** AM Receiver TRF Receiver Super Heterodyne Receiver Image Frequency Rejection, Frequency Changing & Tracking Choice of IF AM Detection AGC SSB Detection. FM Receiver Amplitude Limiter De-Emphasis FM Detection Balanced Slope Detector Phase Discriminator Ratio Detector. Direct and Indirect methods - FM Transmitter Pre-Emphasis.
IV	**PULSE MODULATION** PAM Modulation & Detection PWM Modulation & Detection - PPM Modulation & Detection - Sampling Theorem Quantization & Quantization Error PCM Modulation & Detection - Companding ASK FSK BPSK QPSK DPSK.

Recommended Book

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition

Programme / Class	Certificate	Year	B.Sc.III	Semester	V
Subject	Industrial Electronics (Practical)				
Course Code	B310504P	Course Title	Communication Electronics Lab		

Course Outcomes (COs)

1. Understand basics of communication systems.
2. Build understanding of various analog and digital modulation and demodulation
3. Understand the basics of a digital communication system

Credits: 2

Topics

Lab Experiment List

- Study of Amplitude Modulation and Demodulation.
- Study of Frequency Modulation and Demodulation
- Study of Single Side Band Modulation and Demodulation
- Study of Pulse Amplitude Modulation
- Study of Pulse Width Modulation
- Study of Pulse Position Modulation
- Study of Pulse Code Modulation
- Study of Amplitude Shift Keying
- Study of Frequency Shift Keying
- Study of Phase Shift Keying

Programme / Class	Certificate	Year	B.Sc.III	Semester	V
Subject	Industrial Electronics (Minor)				
Course Code	B310505T	Course Title	Micro-Sensor Design		

Course Outcomes (CO)

1. Understand the basic concepts, history, and applications of Artificial Intelligence.
2. Explain different AI problem-solving methods, search algorithms, and knowledge representation techniques.
3. Apply machine learning fundamentals to classify, predict, and analyze data.
4. Develop simple AI programs using Python and AI libraries for real-world applications.
5. Understand the basics of neural networks, deep learning, natural language processing (NLP), and computer vision.
6. Evaluate AI solutions by considering ethical issues, bias, privacy, and societal impact.

Credits: 3

Unit	Topics
I	Introduction to MEMS and micro fabrication: History of MEMS development, characteristics of MEMS-miniaturization micro-Electronics integration -Mass fabrication with precision. Micro fabrication microelectronics fabrication process- silicon based MEMS processes- new material and fabrication processing points of consideration for processing.
II	Electrical and Mechanical properties of MEMS materials: Conductivity of semiconductors, crystal plane and orientation, stress and stain - definition relationship between tensile stress and stain- mechanical properties of silicon and thin films
III	Sensing and actuation: Electrostatic sensing and actuation-parallel plate capacitor and its application and tactile sensor parallel Plate actuator- comb drive. Thermal sensing and actuations-thermal sensors-actuators and its applications
IV	Piezoresistive sensors Piezoresistive sensor material- stress in flexural cantilever and membrane and its application. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF ZnO and its applications. Magnetic actuation- micro magnetic actuation principle- deposition of magnetic materials-design and fabrication of magnetic coil.

Recommended Book

1. Chang Liu, Foundations of MEMS, Pearson International Edition, 2006.
2. Gaberiel M.Rebiz, RF MEMS Theory Design and Technology, John Wiley & Sons, 2003
3. Charles P.Poole, Frank J.Owens, Introduction to nanotechnology John Wiley & sons.
4. Julian W.Gardner, Vijay K, Microsensors, MEMS and Smart devices, John. Wiley & sons,