Annexure-III

BCA in IoT
(Internet of Things)

Jointly by

Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur

&

National Institute of Electronics and Information Technology, Gorakhpur

(An Autonomous Scientific Society of Ministry of Electronics and Information Technology, Government of India)

BCA in IoT (Internet of Things)

Year	Semester	Subject Code	Subject	L	P	C
First Year	1st Semester	BIT101	IT Tools & Fundamentals of Computer Architecture	4	0	4
		BIT102	Principles of Mathematics	4	0	4
		BIT103	C Programming	4	0	4
		BIT104	Digital Circuit and Logic Design	4	0	4
		BIT105L	C Programming Lab	0	8	4
	2nd Semester	BIT201	Fundamentals of IoT and Applications	4	0	4
		BIT202	Data Communications and Computer Networks	4	0	4
		BIT203	Fundamentals of Cyber Security	4	0	4
		BIT204	Sensors & Devices	4	0	4
		BIT205L	Electronics & Arduino Lab	0	8	4
Second Year	3rd Semester	BIT301	Python Programming in IoT	4	0	4
		BIT302	IoT with Raspberry Pi	4	0	4
		BIT303	IoT Security	4	0	4
		BIT304	Database Management System in IoT	4	0	4
		BIT305L	DBMS & IoT Lab	0	8	4
	4th Semester	BIT401	Artificial Intelligence in IoT	4	0	4
		BIT402	RFID & Sensor Networks	4	0	4
		BIT403N	Effective Communication Skills	4	0	4
		BIT404	Brain Computer Interface	0	8	4
		BIT405L	Mini Project with Seminar	0	8	4
Third Year	5th Semester	BIT501	Machine Learning in IoT	4	0	4
		BIT502	Mechatronics and Robotics	4	0	4
		BIT503	Web Analytics	4	0	4
		BIT504	Industrial Internet of Things	4	0	4
		BIT505P	Project-I	0	8	4

	6th Semester	BIT601	Cloud Computing in IoT	4	0	4
		BIT602N	Employability & Practitioner Skills	4	0	4
		BIT603P	Project-II	0	24	12

Note: L: Lecture**, P:** Practical**, C:** Credit

Note: Student may carry project of 4th Semester to 5th and 6th Semester also. Project must be meaningfully concluded.

First Semester

Subject Code	BIT101
Course Name	IT Tools & fundamentals of Computer Architecture
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Develop understanding of the basic framework of computer & its architecture and process. 2. Understand the fundamentals of Computer Applications. 3. Develop an understanding of the techniques of different tools & software.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Computer & Latest IT gadgets, Characteristics of Computers, Input, Output, Computer Memory & storage, Application Software, Systems Software, Utility Software, Open source and Proprietary Software, Mobile Apps. Number system, Conversion of number system; Binary Coded Decimal (BCD) Code, ASCII Code. Introduction to Operating System, Operating Systems for Desktop, Laptop, Mobile Phone and Tablets, User Interface for Desktop and Laptop, Operating System setting, add or remove Program, adding/removing & sharing Peripherals, File and Folder management, types of file extensions.	**10**
Unit 2: Word Processing: Basics, different parts of application window, Document handling, Save & Save As, Help, Page Setup & Layout, Borders, Watermark, Print, Document Creation, Editing & formatting Text, Undo & Redo, AutoCorrect, Spelling & Grammar, Find and Replace, Header & Footer, Table Creation/ Draw & Manipulation, Border and Shading, Mail Merge, Table of Contents, Indexes, Adding Comments, Tracking changes, Macros. **Spread Sheet:** Creation, Cell Address [Row and Column] & selecting a Cell, Entering Data [text, number, date] in Cells, Page Setup, Printing of Sheet, Manipulation of Cells & Sheet, Modifying / Editing Cell Content , Formatting Cell, Paste & Paste Special, Cell Height and Width, Inserting and Deleting Rows, Column, AutoFill, Sorting & Filtering, Freezing panes, Formulas, Functions and Charts, Using Formulas for Numbers, AutoSum, Functions (Sum, Count, MAX, MIN, AVERAGE, PMT etc.), Sort, Filter, Advanced Filter, Database Functions, What-if Analysis, Pivot table, Data Validation. **Presentation:** Creation of Presentation, Inserting & Editing Text on Slides, Manipulating Slides, Text Formatting, Inserting Table, Adding Pictures, Inserting Other Objects, Resizing and Scaling an Object, Creating & using Master Slide, Set Up for Presentation, Slide Show, Transition and Slide Timings, Automating a Slide Show, Providing Aesthetics to Slides, Presentation, Adding Movie and Sound, Headers, Footers and Notes, Printing Slides and Handouts.	**20**
Unit 3: Introduction to Computer Architecture, Von Neumann Architecture, CPU Structure and Function, Memory Hierarchy, Input and Output Systems, Instruction Set Architecture, Bus Structures, Parallel Processing Concepts, Performance Metrics in Computer Architecture. Binary number system, Boolean algebra basics, Logic gates and	**10**

truth tables, Logic expressions and simplification.	
Unit 4: Advanced Concepts in Computer Architecture Pipeline Processing, Instruction Level Parallelism, Superscalar and VLIW Architectures, Memory Management Techniques, Cache Memory Organization, Virtual Memory Systems, Input/output Processing, Interrupts and Exception Handling, Multiprocessing Systems.	**10**
Unit 5: Future Trends and Challenges Emerging Trends in Computer Architecture, Quantum Computing, Neuromorphic Computing, Energy-Efficient Architectures, IoT and Embedded Systems, Security Considerations in Computer Architecture, Challenges in Parallel Computing, Research Opportunities in Computer Architecture.	**10**

COURSE OUTCOME:

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

1. Identify computers, IT gadgets and explain their evolution and applications & get familiar with various input, output and hardware components of a computer along with storage devices.
2. Get familiar with various types of software, utilities used for computer and mobile apps.
3. Word Processing, their usage, details of word processing screen.
4. Basic Knowledge of Spreadsheet Processing, their usage.

Recommended Readings

1. LibreOffce, Getting Started Guide by LibreOffce Documentation Team
2. OpenOffice.org for DUMMIES by GurdyLeete, Ellen Finkelstein and Mary Leete
3. "Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy
4. "Structured Computer Organization" by Andrew S. Tanenbaum

Subject Code	BIT102
Course Name	Principles of Mathematics
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Develop a solid understanding of foundational mathematical concepts. 2. Understand the Functions, Matrix & Determinants. 3. Understand Progression & concepts of Statistics.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Sets and Relations: Elements of a set, methods of describing a set, types of set, subsets, Venn diagram, Operations on sets, union, intersection and difference of set, Duality, partitioning of a set, min sets, duality principle, relation between sets, Binary relations, Operations on relations, Equivalence relations, Composition of relations. Functions, different types of functions, Inverse functions, Composition of Functions, Trigonometric functions, Binomial theorem and principle of mathematics induction. Functions, graphics of relations, properties of relations; injective, subjective and bijective functions, Composition.	**12**
Unit 2: Matrix and Determinants: Introduction to matrix, properties of matrix; evaluation of determinant, minor and cofactors and Properties of determinant, different operations on matrices. Introduction to Progression, Arithmetic Progression, Geometric Progression, Harmonic Progression, Arithmetic mean, Geometric mean, Harmonic mean. Introduction to statistics, collection, and tabulation of data, different types of charts and graphs. Measures of central tendency. Preparing frequency distribution table, arithmetic mean. Geometric mean, harmonic mean, median and mode. Measures of dispersion: Range, mean deviation, Standard deviation, co-efficient of variation, moments, Skewness and Kurtosis.	**12**
Unit 3: Algebra of Logic: Proposition and logical operators, negation, conjunction, disjunction, conditional and biconditional, constructions of truth table, tautologies and contradictions, equivalence of formula, well formed formula, normal forms. Calculus: Differentiation, Derivative of a. Function of One Variable, Power Function, Sum and Product of Two. Functions, Function of a Function. Differentiation by method of Substitution, Maxima and Minima. Indefinite Integral, Integration by substitution, integration by parts. Integration by Partial fractions, definite integral.	**12**
Unit 4: Recursion and recurrence: recursion, recursion and iteration, close form expression, sequence of integers, recurrence relations, linear homogeneous and non-homogeneous recurrence relations, generating functions. Graph and Trees: Various types of graphs, simple and multigraphs, directed and undirected graphs, Representation of graphs in computer memory, Adjacency matrix, Incidence matrix, linked representation, Tree terminology , Types of tree, binary tree, tree traversal , binary search tree.	**12**
Unit 5: Introduction to Numerical computing, significant digits, errors, error propagation, roots of non linear equations, bisection methods, false position methods,	**12**

Newton Raphson method, Secant method. Matrix and Linear equation, pivotal condensation method, system of linear equations, Gauss elimination method, Gauss Jordan Method, Gauss Seidel iteration Method. Numerical Differentiation and Integration : Linear Interpolation, Lagrange Interpolation Polynomial, Newton Interpolation Polynomial, Differentiating Continuous functions. Differentiating tabulated functions, Newton- cotes methods of integration , Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rules.	

COURSE OUTCOME:

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

1. Understand the fundamental mathematical concepts.
2. Understand functions, matrix etc.
3. Interpret and analyze data charts and graphs etc.

Recommended Readings

1. "Concrete Mathematics: A Foundation for Computer Science" by Ronald L. Graham, Donald E. Knuth, and Oren Patashnik
2. "Discrete Mathematics with Applications" by Susanna S. Epp
3. "Introduction to Graph Theory" by Richard J. Trudeau
4. "Combinatorial Problems and Exercises" by László Lovász, József Pelikán, and Katalin L. Vesztergombi
5. "A Walk Through Combinatorics: An Introduction to Enumeration and Graph Theory" by Miklós Bóna
6. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill, and D.C. Boes, Tata McGrawHill Pub. Co. Ltd

Subject Code	BIT103
Course Name	C Programming
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Understand the fundamentals and intermediates of C programming. 2. Develop an understanding of the development techniques of different programs and software.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
UNIT 1: Introduction to Programming: The Basic Model of Computation, Algorithms, Flow-charts, Programming Languages, Compilation, Linking and Loading, Testing and Debugging, documentation. Character set, Variables, and Identifiers, Built-in Data Types, Variable Definition. Arithmetic operators and Expressions, Constants and Literals. Simple Assignment Statement, Basic input/output statement, Simple 'C' programs.	**10**
UNIT 2: Conditional Statements and Loops: Decision making within a program, Conditions, Relational Operators. If- statements. If-else statement, Switch case Statement. Loops: while loop, do while, for loop, Nested loops, Infinite loops, unconditional branching with Goto statement, Structured Programming.	**10**
UNIT 3: Arrays and Functions: One dimensional arrays: -Array manipulation; Insertion. Deletion of an element from an array; Finding the largest/smallest element in an array; two dimensional arrays, Addition Multiplication of two matrices. Transpose of a square matrix; Null terminated strings as array of characters. Modular programming and functions. Standard Library of C functions, Prototype of a function: formal parameter list; Return Type, Function call, Block Structure, Passing arguments to a Function: call by reference. call by value, Recursive Functions, Arrays as function arguments.	**15**
UNIT 4: Structures, Unions and Pointers: Structure variables, initialization, structure assignment, nested structure structures and functions, structures and arrays: arrays of structures, structures containing arrays. Unions. Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays.	**12**
Unit 5: File Processing: Concept of files, File opening in various modes and closing of a file, Reading from a file, writing onto a file, Dynamic Accessing of file. Dynamic Memory Allocation, Advanced Pointer Concepts, Bitwise Operations in 'C', Recursion and Recursive Data Structures, Advanced File Handling, Command Line Arguments, Preprocessor Directives, Multi-file Programming, Debugging Techniques, Optimization Strategies. Case Studies and Examples	**13**

COURSE OUTCOME:
At the end of this course students will be able to: 1. Develop efficient algorithms for solving a problem. 2. Use the various constructs of a programming language viz. conditional, iteration and recursion. 3. Use simple data structures like arrays, stacks and linked list in solving problems.

Recommended Readings

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie
2. "Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy
3. "C Programming: A Modern Approach" by K.N. King
4. "Structured Computer Organization" by Andrew S. Tanenbaum
5. "Head First C: A Brain-Friendly Guide" by David Griffiths and Dawn Griffiths
6. Byron S Gottfried “Programming with C” Second edition, Tata McGrawhill
7. Kanetkar Y, “Let us C”, BPB Publications
8. E. Balagurusamy, “Programming with ANSI-C”, Tata McGraw Hill.

Subject Code	BIT104
Course Name	Digital Circuit and Logic Design
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Develop a solid understanding of the fundamental principles and techniques of digital circuit and logic design.
2. Acquire proficiency in designing and analyzing combinational and sequential logic circuits.
3. Gain hands-on experience with programmable logic devices (PLDs) and memory systems.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Boolean Algebra & Logic Gates, Karnaugh maps, Combinational logic circuits, Introduction to sequential logic, Logic minimization techniques, Introduction to CAD tools for digital design, Introduction to synchronous and asynchronous circuits.	**14**
Unit 2: Adders and subtractors, Multiplexers and demultiplexers, Encoders and decoders, Comparators, Arithmetic logic units (ALUs), Programmable logic devices (PLDs), Introduction to HDLs (Hardware Description Languages), Design of combinational circuits for specific applications, Testing and verification of combinational circuits.	**14**
Unit 3: Flip-flops and latches, Sequential circuit analysis, State diagrams and state tables, Mealy and Moore machines, Counters and shift registers, Finite State Machine (FSM) design, Clocking methodologies, Sequential circuit optimization techniques, Hazard detection and elimination, Timing analysis in sequential circuits.	**12**
Unit 4: Memory types and organization, Read Only Memory (ROM) and Random Access Memory (RAM), Programmable Logic Arrays (PLAs), Field Programmable Gate Arrays (FPGAs), Memory-mapped I/O, Designing memory circuits, Memory hierarchy and cache organization, Error detection and correction in memory systems.	**8**
Unit 5: Timing analysis and synchronization, Asynchronous sequential logic design, Register transfer level (RTL) design, Digital signal processing fundamentals, Introduction to hardware description languages (VHDL/Verilog), High-level synthesis (HLS) for digital design, Design for testability (DFT) techniques, Power optimization in digital circuits.	**12**

COURSE OUTCOME

1. Demonstrate proficiency in designing and implementing combinational and sequential logic circuits.
2. Analyze and optimize digital circuits for performance, power, and area constraints.
3. Utilize hardware description languages (HDLs) to model and simulate digital systems.

Recommended Readings

1. "Digital Design: Principles and Practices" by John F. Wakerly.

2. "Digital Design and Computer Architecture" by David Money Harris and Sarah L. Harris.
3. "Fundamentals of Digital Logic with Verilog Design" by Stephen Brown and Zvonko Vranesic.
4. "Introduction to Logic Design" by Alan B. Marcovitz.

Subject Code	BIT105L
Course Name	C Programming Lab
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Reinforce the fundamental concepts of C programming language 2. Develop problem-solving skills by solving programming challenges and exercises using C. 3. Enhance programming proficiency by providing them with opportunities to write, compile, debug, and execute C programs.

LAB EXPERIMENTS
Lab 1: Basic Syntax and Output
Lab 2: Variables and Data Types
Lab 3: Conditional Statements and Loops
Lab 4: Arrays and Strings Manipulation
Lab 5: Functions and Modular Programming
Lab 6: Pointers and Dynamic Memory Allocation
Lab 7: File Input/Output Operations
Lab 8: Structures and Unions Implementation
Lab 9: Advanced Data Structures (Linked Lists, Stacks, Queues)
Lab 10: Sorting and Searching Algorithms

Note*: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.*

COURSE OUTCOME
1. Students will demonstrate proficiency in understanding and applying basic programming constructs. 2. Students will develop problem-solving skills by effectively analyzing problems, designing algorithms, and implementing solutions using C programming techniques. 3. Students will gain a solid understanding of fundamental data structures and algorithms.

Recommended Readings

1. "The C Programming Language" by Brian Kernighan and Dennis Ritchie.

2. "C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller.
3. "Head First C" by David Griffiths and Dawn Griffiths.
4. "C Primer Plus" by Stephen Prata.
5. "C Programming: A Modern Approach" by K.N. King.

Second Semester

Subject Code	BIT201
Course Name	Fundamentals of IoT and Applications
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Develop understanding of the basic framework of the Internet of Things, its process, and various techniques. 2. Understand the different applications and use cases of Internet of Things. 3. Develop an understanding of the development of IoT systems and projects.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.	**14**
Unit 2: Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Net Arduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.	**14**
Unit 3: Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.	**12**
Unit 4: Programming the Arduino: Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IoT.	**8**
Unit 5: Challenges in IoT Design challenges: Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.	**12**

COURSE OUTCOME
1. Understand IoT fundamentals, including architecture and communication protocols. 2. Learn to design and implement IoT applications for various domains. 3. Develop practical skills in deploying and managing IoT solutions.

Recommended Readings

1. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, Elsevier, 2016.
2. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, Wiley, 2016.
3. "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World" by Scott Klein, Dan Fernandez, Wiley, 2017.
4. "IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy" by Bruce Sinclair, McGraw-Hill Education, 2017.
5. "Designing Connected Products: UX for the Consumer Internet of Things" by Claire Rowland, Elizabeth Goodman, Martin Charlier, and Ann Light, O'Reilly Media, 2015.

Subject Code	BIT202
Course Name	Data Communications and Computer Networks
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Gain a deep understanding of data communication principles and network protocols.
2. Apply theoretical knowledge to analyze, design, and optimize network architectures.
3. Develop practical skills in network configuration and management.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: Introduction to data communication and networking, Data communication models and standards, OSI and TCP/IP reference models, Network topologies and architectures, Transmission media and signal encoding techniques	**12**
Unit 2: Internet Protocol (IP) addressing and subnetting, Address Resolution Protocol (ARP) and Internet Control Message Protocol (ICMP), Routing algorithms and protocols (e.g., RIP, OSPF, BGP), Transmission Control Protocol (TCP) and User Datagram Protocol (UDP), Domain Name System (DNS) and Dynamic Host Configuration Protocol (DHCP)	**12**
Unit 3: Ethernet fundamentals and IEEE 802 standards, LAN technologies: Ethernet, Token Ring, and Wireless LANs, Ethernet frame format and addressing, Ethernet switching and VLANs, LAN troubleshooting and performance optimization	**12**
Unit 4: WAN fundamentals: Circuit-switched vs. Packet-switched networks, WAN technologies: Leased lines, Frame Relay, ATM, and MPLS, PPP and HDLC protocols, Network Address Translation (NAT) and Port Address Translation (PAT), Virtual Private Networks (VPNs) and Tunneling protocols	**12**
Unit 5: Network security fundamentals: Threats, vulnerabilities, and countermeasures, Authentication, authorization, and accounting (AAA), Firewalls and Intrusion Detection Systems (IDS), Network management protocols: SNMP and RMON, Quality of Service (QoS) and Network Monitoring	**12**

COURSE OUTCOME

1. Understand the principles and fundamentals of data communications and computer networks.
2. Learn about various networking protocols, architectures, and technologies.
3. Develop skills in designing, implementing, and managing computer networks.

Recommended Readings

1. "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross
2. "TCP/IP Illustrated, Volume 1: The Protocols" by W. Richard Stevens
3. "Data and Computer Communications" by William Stallings
4. "Computer Networks: A Systems Approach" by Larry L. Peterson and Bruce S. Davie
5. "Network Security Essentials: Applications and Standards" by William Stallings

Subject Code	BIT203
Course Name	Fundamentals of Cyber Security
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Understand the basics of cyber security principles and techniques.
2. Explore real-world applications and case studies of cyber security.
3. Develop practical skills to identify, analyze, and mitigate cyber threats effectively.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: Introduction to Cyber Security: Overview, Importance, And Evolution of Cyber Threats, Cyber Attacks, Cyber Security Terminology, Cyber Security Frameworks, Cyber Security Policies and Regulations.	**12**
Unit 2: Fundamentals of Cryptography: Basic Concepts of Cryptography, Symmetric Encryption, Asymmetric Encryption, Hash Functions, Digital Signatures, Public Key Infrastructure (PKI), Cryptographic Protocols.	**12**
Unit 3: Network Security: Overview of Network Security, Network Threats and Attacks, Firewalls, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS), Virtual Private Networks (VPN), Secure Socket Layer (SSL)/Transport Layer Security (TLS), Wireless Network Security, Secure Email and Web Browsing.	**12**
Unit 4: Cyber Security in IoT: IoT Security Challenges, Secure Communication Protocols for IoT, Authentication and Access Control in IoT, Data Privacy and Integrity in IoT, IoT Device Security, Threat Modeling for IoT, Secure Firmware Development for IoT Devices.	**12**
Unit 5: Cyber Security Operations and Incident Response: Incident Response Process, Threat Intelligence, Cyber Security Operations Center (CSOC), Security Incident and Event Management (SIEM), Digital Forensics, Incident Handling and Reporting, Legal and Ethical Issues in Incident Response.	**12**

COURSE OUTCOME

1. Understand cybersecurity concepts, laws, and best practices.
2. Learn security controls and technologies for threat mitigation.
3. Develop skills in risk assessment and incident response.

Recommended Readings

1. "Cybersecurity Essentials" by Charles J. Brooks
2. "Introduction to Cybersecurity" by Troy McMillan
3. "Cybersecurity: A Practical Guide to the Law of Cyber Risk" by David Bender and Daniel Garrie
4. "CISSP All-in-One Exam Guide" by Shon Harris and Fernando Maymi
5. "Hacking: The Art of Exploitation" by Jon Erickson

Subject Code	BIT204
Course Name	Sensors & Devices
Credits	4

COURSE OBJECTIVE

1. Introduce students to a variety of sensors and devices used in different applications.
2. Provide a fundamental understanding of sensor principles.
3. Familiarize students with different types of sensors.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Sensors & Transducers: Principles, Classification, Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Inductive Sensors, Capacitive Sensors- Parallel plate & serrated plate types, Ultrasonic Sensors.	**10**
Unit 2: Thermal Sensors: Introduction, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Junction Semiconductor Types. Magnetic Sensors: Introduction, Sensors and the Principles Behind, Force & displacement Sensors.	**10**
Unit 3: Environment Sensors: Temperature sensor, Humidity sensor, Sound sensor, Motion detection sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor, Chemical/smoke and gas sensor Level sensor. Radiation Sensors: Introduction – Basic Characteristics – Types of Photo sensistors /Photo detectors– X-ray and Nuclear Radiation Sensors – Fiber Optic Sensors.	**10**
Unit 4: Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Medical Diagnostic Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring	**15**
Unit 5: Actuators: Pneumatic and Hydraulic Actuation Systems, Valves, Rotary actuators, Mechanical Actuation Systems Electrical Actuation Systems. Optical device drivers and their devices: Light-emitting diode. Displays: Liquid-crystal display (LCD), Organic light-emitting diode display (OLED), Electronic ink display (E ink). Mechanical drivers, Relay, Solenoid, Speaker, DC motor (one direction), Stepper motor, Servomotor.	**15**

COURSE OUTCOME

1. Define the general concepts of sensors used in IoT
2. Classify proximity, ultrasound and motion sensors based on knowledge and principles of working.
3. Compare various environmental sensors.

Recommended Readings

1. "Principles of Modern Sensors" by Fraden Jacob.
2. "Sensor Technology Handbook" by Jon S. Wilson.

3. "Smart Sensors and Applications" edited by Yanguo Liu and Hongwen Yang.
6. "Fundamentals of Sensors for Engineering and Science" by Patrick F. Dunn.

Subject Code	BIT205L
Course Name	Electronics & Arduino Lab
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Introduce students to the fundamentals of electronics and circuit design.
2. Provide hands-on experience with electronic components and circuit construction techniques.
3. Familiarize students with the Arduino microcontroller platform and its applications.

LAB EXPERIMENTS
Lab 1: Introduction to Arduino: Blinking LED
Lab 2: Reading Potentiometer Values and Controlling LED Brightness
Lab 3: Working with Sensors: Temperature and Light Sensors
Lab 4: Controlling Servo Motors
Lab 5: Interfacing with LCD Displays
Lab 6: Wireless Communication: Bluetooth and Wi-Fi Modules
Lab 7: Data Logging with SD Card Module
Lab 8: Advanced Sensor Integration: Accelerometer and Gyroscope
Lab 9: Reading Analog Sensor Values with Arduino
Lab 10: Project Showcase: Implementing a Mini Smart Home System

***Note**: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.*

COURSE OUTCOME

1. Gain hands-on experience with sensors and actuators.
2. Design and implement Arduino-based projects
3. Enhance understanding of circuit design principles

Recommended Readings

1. "Arduino Cookbook" by Michael Margolis
2. "Getting Started with Arduino" by Massimo Banzi and Michael Shiloh

3. "Arduino Projects Book" by Scott Fitzgerald
4. "Make: Electronics: Learning Through Discovery" by Charles Platt
6. "Practical Electronics for Inventors" by Paul Scherz and Simon Monk

Third Semester

Subject Code	BIT301
Course Name	Python Programming in IoT
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Acquire proficiency in Python programming language syntax, data structures, and control flow. 2. Develop problem-solving skills through hands-on programming in Internet of Things. 3. Understand fundamental programming concepts such as object-oriented programming, functions, and modules in the context of Python.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Python Programming - Basic syntax and data types, Control flow statements (if-else, loops), Functions and modules, Input/output operations, Exception handling, Debugging techniques, Documentation and comments, Python programming environment setup, Best practices and coding conventions.	**12**
Unit 2: Python for IoT Device Control - Introduction to IoT and its applications, Understanding IoT devices and sensors, Interfacing with sensors using Python, Controlling actuators and devices with Python, IoT data acquisition and processing, MQTT protocol for IoT communication, Implementing IoT protocols in Python	**12**
Unit 3: Data Analysis and Visualization for IoT - Collecting and storing IoT data, Data preprocessing and cleaning with Python, Exploratory data analysis (EDA) techniques, Data visualization using libraries like Matplotlib and Seaborn, Real-time data streaming and visualization, Time series analysis for IoT data, IoT data aggregation and summarization, Anomaly detection and predictive analytics for IoT	**12**
Unit 4: Python Development in Raspberry Pi - Introduction to Raspberry Pi and its capabilities, Setting up Raspberry Pi for Python development, GPIO programming with Python for hardware interfacing, Using sensors and actuators with Raspberry Pi, Building IoT applications on Raspberry Pi, Integrating Raspberry Pi with cloud services, Remote access and monitoring of Raspberry Pi projects	**12**
Unit 5: IoT Application Development with Python - Overview of IoT application development lifecycle, Designing IoT solutions with Python, Building end-to-end IoT applications, Integrating cloud services with Python, Implementing IoT security measures in applications, IoT application testing and debugging strategies, Deployment and maintenance of IoT applications	**12**

COURSE OUTCOME
1. Develop proficiency in Python programming for IoT device control, data analysis, and application development. 2. Gain expertise in processing and visualizing IoT data using Python libraries and tools. 3. Demonstrate proficiency in completing real-world IoT projects and case studies using Python programming.

Recommended Readings

1. "Python for Data Analysis" by Wes McKinney
2. "Raspberry Pi Cookbook" by Simon Monk
3. "Internet of Things with Python" by Gastón C. Hillar
4. "Python Programming for Raspberry Pi" by Donald Norris
5. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalil

Subject Code	BIT302
Course Name	IoT with Raspberry Pi
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Understand the fundamental concepts of the Internet of Things (IoT) and its applications.
2. Develop skills in interfacing sensors, actuators, and other IoT devices with Raspberry Pi.
3. Collaborate effectively with peers to develop innovative IoT solutions and projects.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to IoT and Raspberry Pi - Overview of Internet of Things (IoT), Introduction to Raspberry Pi, IoT Applications and Use Cases, Basics of Electronics and Sensors, Introduction to Python Programming for Raspberry Pi, Introduction to GPIO (General Purpose Input Output), Setting up Raspberry Pi Operating System, Connecting Raspberry Pi to the Internet	**12**
Unit 2: Setting up Raspberry Pi for IoT Development - Choosing the Right Raspberry Pi Model, Installing Raspbian OS on Raspberry Pi, Configuring Network Settings, Enabling SSH and VNC for Remote Access, Managing Packages and Dependencies, Updating Firmware and Software, Setting up Development Environment, Configuring GPIO Pins, Exploring Raspberry Pi GPIO Libraries,	**12**
Unit 3: Interfacing Sensors and Actuators with Raspberry Pi - Introduction to Sensors and Actuators, Types of Sensors: Temperature, Humidity, Light, Motion, etc., Interfacing Digital Sensors with Raspberry Pi, Interfacing Analog Sensors with Raspberry Pi, Controlling Actuators: Motors, Servos, Relays, etc., Introduction to Sensor Data Acquisition, Reading Sensor Data using GPIO Pins	**12**
Unit 4: Project Development with Raspberry Pi - Understanding IoT Project Lifecycle, Project Planning and Requirements Analysis, Designing System Architecture, Prototyping IoT Solutions with Raspberry Pi, Implementing Data Acquisition and Processing, Implementing Communication Protocols: MQTT, HTTP, etc., Cloud Integration: AWS IoT, Google Cloud IoT Core, etc., Data Visualization and Dashboard Creation, Testing and Debugging IoT Applications	**12**
Unit 5: Advanced Topics in IoT with Raspberry Pi - Edge Computing and Edge Analytics, Security Considerations in IoT Applications, Machine Learning at the Edge with Raspberry Pi, Edge-to-Cloud Integration and Data Sync, Power Management and Energy Efficiency, Building Custom IoT Devices with Raspberry Pi Compute Module, Real-time Operating Systems for IoT, Industrial IoT (IIoT) Applications with Raspberry Pi, IoT Standards and Protocols: CoAP, LoRaWAN, Zigbee	**12**

COURSE OUTCOME

1. Gain practical proficiency in implementing IoT solutions using Raspberry Pi.
2. Understand the fundamental concepts of Internet of Things (IoT) and its applications.
3. Learn to interface sensors, actuators, and other IoT devices with Raspberry Pi.

Recommended Readings

1. "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions" by Simon Monk
2. "IoT Projects with Raspberry Pi" by John C. Shovic and Matthew Poole
3. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic and Jeff Geerling
4. "Raspberry Pi IoT In Python Using GPIO Zero" by Harry Fairhead
5. "Learning IoT with Raspberry Pi" by Peter Waher

Subject Code	BIT303
Course Name	IoT Security
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Master advanced cybersecurity principles and techniques customized for IoT environments.
2. Analyze and mitigate emerging cyber threats specific to IoT ecosystems.
3. Gain practical experience in implementing advanced cybersecurity solutions for IoT devices and networks.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Fundamentals of Cybersecurity for IoT - Cybersecurity principles and concepts, Threat landscape analysis in IoT, Vulnerability assessment and risk management, Secure design and architecture for IoT, Regulatory compliance and standards, Secure coding practices for IoT devices, Incident response and recovery in IoT environments.	**12**
Unit 2: IoT Device Security - Secure bootstrapping and provisioning, Device authentication and access control, Secure communication protocols, Firmware and software updates, Hardware security mechanisms, Secure coding techniques for IoT firmware, Trustworthiness verification of IoT devices	**12**
Unit 3: IoT Network Security - Deployment and configuration, Network segmentation and isolation, Intrusion detection and prevention systems, Wireless communication security, IoT-specific network protocols, Secure configuration management for IoT networks, Security monitoring and threat hunting in IoT networks	**12**
Unit 4: IoT Data Security - Data encryption and integrity protection, Secure storage and transmission, Privacy-preserving techniques, Data anonymization and pseudonymization, Access control and data sharing, Blockchain for secure IoT data management, Secure data lifecycle management in IoT systems	**12**
Unit 5: Advanced Topics in IoT Security - Threat intelligence and modeling, Security analytics and anomaly detection, Blockchain for IoT security and trust, Edge computing security, Defense against advanced threats, Quantum cryptography for securing IoT communications, Secure firmware update mechanisms for IoT devices	**12**

COURSE OUTCOME

1. Analyze and mitigate emerging IoT cyber threats.
2. Design and implement comprehensive IoT security solutions.
3. Communicate cybersecurity risks and recommendations clearly.

Recommended Readings

1. "IoT Security: A Practical Guide Book" by Brian Russell, Drew Van Duren, John Sammons
2. "Practical Internet of Things Security" by Brian Russell, Drew Van Duren

3. "Building Secure and Reliable Systems: Best Practices for Designing, Implementing, and Maintaining Systems" by Heather Adkins, Betsy Beyer, Paul Blankinship, Ana Oprea, Piotr Lewandowski
4. "IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy" by Bruce Sinclair
5. "Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS" by Tyson Macaulay, Bryan L. Singer

Subject Code	BIT304
Course Name	Database Management System in IoT
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Understand fundamental principles of database management systems.
2. Gain proficiency in designing and managing databases.
3. Explore advanced topics such as transaction management and indexing.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Database Fundamentals, Introduction to DBMS, Data Models (Relational, NoSQL), Introduction to IoT and its Data Management Challenges, Role of DBMS in IoT, Data Modeling for IoT Applications, Case Studies and Examples	**12**
Unit 2: Relational Data Model, SQL Basics, Introduction to RDBMS (e.g., MySQL, PostgreSQL), Data Integrity and Constraints, Transactions and Concurrency Control, Indexing and Query Optimization, RDBMS Integration in IoT, Case Studies and Examples	**12**
Unit 3: NoSQL Data Model, Types of NoSQL Databases (e.g., Document, Column-family, Key-value, Graph), Introduction to NoSQL Databases (e.g., MongoDB, Cassandra, Redis), CAP Theorem and Consistency Models, NoSQL Data Modeling for IoT, Scaling and Performance in NoSQL, Case Studies and Examples	**12**
Unit 4: Data Stream Management Systems (DSMS), Time-series Databases, Data Warehousing and OLAP, Big Data Platforms (e.g., Hadoop, Spark), Data Integration and ETL (Extract, Transform, Load), Data Analytics and Machine Learning for IoT, Security and Privacy in IoT Data Management, Case Studies and Examples	**12**
Unit 5: IoT Data Processing Architectures, Edge Computing and Edge Databases, Blockchain and Distributed Ledger Technologies for IoT Data Management, IoT Data Visualization and Dashboards, IoT Data Governance and Compliance, Emerging Trends and Research Directions in DBMS for IoT	**12**

COURSE OUTCOME

1. Understand fundamental principles and concepts of database management systems (DBMS).
2. Design and implement efficient and scalable databases using industry-standard techniques and tools.
3. Apply normalization techniques and best practices to design robust and maintainable database schemas.

Recommended Readings

1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, S. Sudarshan
2. "Database Management Systems" by Raghu Ramakrishnan, Johannes Gehrke
3. "Fundamentals of Database Systems" by Ramez Elmasri, Shamkant B. Navathe
4. "SQL Performance Explained" by Markus Winand

Subject Code	BIT305L
Course Name	DBMS & IoT Lab
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Gain practical experience in database design and SQL querying. 2. Apply normalization techniques and advanced database concepts. 3. Understand database administration and management principles in IoT.

LAB EXPERIMENTS
Lab 1: Introduction to Database Concepts: Understanding Data, Information, and Database Systems.
Lab 2: Relational Database Fundamentals: Explaining Tables, Rows, Columns, and Relationships.
Lab 3: SQL Basics: Learning to Write Simple SELECT, INSERT, UPDATE, and DELETE Queries.
Lab 4: Entity-Relationship (ER) Modeling: Designing Basic Entity-Relationship Diagrams for IoT Applications.
Lab 5: Normalization: Understanding First, Second, and Third Normal Forms for Data Organization.
Lab 6: Implementing Primary and Foreign Keys in Relational Databases for Data Integrity.
Lab 7: Indexing and Query Optimization: Improving Performance in Database Retrievals.
Lab 8: NoSQL Database Introduction: Exploring Key-Value, Document, and Column-family NoSQL Databases.
Lab 9: CRUD Operations in NoSQL Databases: Inserting, Retrieving, Updating, and Deleting IoT Data.
Lab 10: Transaction Management: Ensuring Consistency and Isolation in IoT Data Operations.

Note*: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.*

COURSE OUTCOME
1. Proficiency in SQL querying and database manipulation. 2. Skills in database design, normalization, and optimization 3. Competence in database administration tasks such as backup, recovery, and performance tuning

Recommended Readings

1. "SQL Queries for Mere Mortals: A Hands-On Guide to Data Manipulation in SQL" by John L. Viescas

2. "Database Design for Mere Mortals: A Hands-On Guide to Relational Database Design" by Michael J. Hernandez
3. "Learning SQL: Generate, Manipulate, and Retrieve Data" by Alan Beaulieu
4. "Database Systems: The Complete Book" by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
5. "Database Concepts" by David M. Kroenke, David J. Auer

Fourth Semester

Subject Code	BIT401
Course Name	Artificial Intelligence in IoT
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Prototype real-world AI-enabled IoT apps. 2. Collaborate on AI-driven IoT projects. 3. Integrate AI with IoT sensor data.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to AI in IoT - Understanding AI's role in IoT, Exploring ML and DL for IoT, Addressing AI challenges on IoT devices, Hands-on: Basic ML algorithms on IoT data, Introduction to IoT architectures, Overview of edge computing in IoT, Introduction to cloud-based AI services for IoT.	**12**
Unit 2: AI Techniques for IoT - Deep dive into ML and DL algorithms, Reinforcement learning for IoT applications, Transfer learning in IoT contexts, Case studies: AI-powered IoT projects, Advanced neural network architectures for IoT, Generative adversarial networks (GANs) for IoT data generation, Time-series analysis techniques for IoT sensor data	**12**
Unit 3: AI Model Deployment on IoT Devices - Challenges of deploying AI on IoT devices, Optimizing AI models for edge computing, Implementing efficient inference on IoT edge devices, Hands-on: Deploying ML models on Raspberry Pi, Model compression techniques for IoT devices, Federated learning for distributed IoT environments, Security considerations in AI model deployment on IoT	**12**
Unit 4: Intelligent IoT Systems Design - Design principles for intelligent IoT systems, Sensor data fusion techniques for AI-driven IoT, Real-time decision-making in IoT environments, Project: Designing an AI-enabled IoT solution, Human-centric design for AI-powered IoT applications, Edge-to-cloud integration strategies for intelligent IoT systems, Predictive maintenance techniques for IoT-enabled machinery	**12**
Unit 5: Ethical and Social Implications of AI in IoT - Ethical considerations in AI-enabled IoT, Privacy issues in AI-driven IoT applications, Impact of AI on society and industry, Case studies: Ethical dilemmas in AI for IoT, Bias and fairness in AI algorithms for IoT, Regulatory frameworks for AI in IoT applications, Responsible AI development practices for IoT ecosystems	**12**

COURSE OUTCOME
1. Address challenges in deploying AI on IoT devices. 2. Consider ethics and responsible AI practices. 3. Prototype real-world AI-enabled IoT apps.

Recommended Readings

1. "Artificial Intelligence for the Internet of Things" by Marco Aiello and Marco Avvenuti
2. "Hands-On Artificial Intelligence for IoT" by Amita Kapoor and Antonio Vigliar
3. "IoT and Edge Computing for Artificial Intelligence" by Min Chen, Zhenzhen Hu, and Hui Cheng
4. "Artificial Intelligence and Internet of Things" by S. Bharathi, A. Punitha, and S. Sakthivel
5. "Building Smart Internet of Things (IoT) Applications" by Sridhar Alla and Rahul Tiwari

Subject Code	BIT402
Course Name	RFID & Sensor Networks
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Understand RFID and Sensor Networks principles. 2. Develop practical skills in deployment. 3. Explore integration with IoT technologies.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Fundamentals of RFID: RFID principles, System components, Frequency bands, RFID standards, Applications, Passive RFID tags, Active RFID tags, Semi-passive RFID tags, RFID tag antennas and tag memory.	**12**
Unit 2: RFID Technology and Deployment: RFID tag selection criteria, RFID tag testing and certification, RFID tag lifecycle management, RFID tag integration, Fixed RFID readers, Handheld RFID readers, Mobile RFID readers, RFID reader antennas, RFID reader protocols	**12**
Unit 3: RFID Middleware and Integration: RFID middleware architecture, Middleware functions and deployment, RFID middleware integration, software tools, RFID software development kits (SDKs), Software customization, Software testing and validation, Software security	**12**
Unit 4: Introduction to Sensor Networks: Sensor network architecture, Sensor network components, Sensor node types, Sensor network topologies, Sensor network protocols, Sensor network applications, Sensor network deployment considerations, Sensor network security, Sensor network integration	**12**
Unit 5: Advanced Sensor Network: Sensor node hardware, Sensor node power sources, Sensor node sensors and actuators, Sensor node communication interfaces, Sensor node programming platforms, Sensor node energy harvesting, Sensor node calibration and testing, Sensor node maintenance, Sensor node lifecycle management	**12**

COURSE OUTCOME
1. Explore integration strategies for RFID and Sensor Networks with other IoT technologies. 2. Evaluate the performance and effectiveness of RFID and Sensor Networks solutions in real-world scenarios. 3. Develop practical skills in deploying and managing RFID and Sensor Networks for various applications.

Recommended Readings

1. "RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication" by Klaus Finkenzeller
2. "Wireless Sensor Networks: Principles, Design and Applications" by Shakil Akhtar

3. "RFID and Sensor Networks: Architectures, Protocols, Security, and Integrations" by Yiming Ji and Tom Shih
4. "Sensor Networks: Where Theory Meets Practice" by Azzedine Boukerche
5. "RFID Technologies: Emerging Trends and Applications" edited by Cristina Turcu

Subject Code	BIT403N
Course Name	Effective Communication Skills
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Enhance verbal and written communication for various contexts. 2. Improve listening, empathy, and conflict resolution skills. 3. Improve oral communication abilities in public speaking and presentations. 4. Enhance written communication skills in reports, essays, and correspondence.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context. Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers	**10**
Unit 2: Elements of Communication: Introduction, Face to Face Communication – Tone of voice, Body Language (Non-Verbal Communication), Verbal Communication Physical Communication. Communication Styles: Introduction, The Communication Styles Matrix -Direct Communication style, Spirited Communication style, Systematic Communication style, Considerate Communication style. Public speaking techniques: Persuasion and influence, Captivating your audience, Executive communication: Communicating with authority and impact, Strategic storytelling: Crafting compelling narratives, Advanced body language mastery: Non-verbal cues for leadership	**15**
Unit 3: Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. Advanced active listening strategies: Empathy and rapport building, Emotional intelligence in communication: Managing emotions effectively, Conflict resolution & negotiation tactics: : Negotiation and mediation, Achieving win-win outcomes, Building high-performance teams: Communication for collaboration	**10**
Unit 4: Interview Skills: Purpose of an interview, Do's and Don'ts of an interview. Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery. Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	**10**
Unit 5: Effective Written Communication: Subject Lines, Introduction, Know Your Audience, Organization of the Message. Put the Main Point First, Shades of Meaning, Formal Communication. Strategic report writing: Crafting influential and data-driven reports, Advanced essay composition: Argumentation and critical analysis, Professional writing for diverse audiences and purposes, Advanced grammar and style: Polishing your writing for precision, Technical writing skills: Communicating complex information clearly. Digital platform: Creating engaging content, Social media management and	**15**

brand communication, Virtual communication platforms and immersive technologies, Data-driven communication: Using analytics for strategic communication	

COURSE OUTCOME

1. Enhance oral, written, and interpersonal communication skills.
2. Adapt communication strategies for diverse contexts
3. Explore communication technology trends

Recommended Readings

1. "How to Win Friends and Influence People" by Dale Carnegie
2. "Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler
3. "The 7 Habits of Highly Effective People" by Stephen R. Covey
4. "Difficult Conversations: How to Discuss What Matters Most" by Douglas Stone, Bruce Patton, and Sheila Heen
5. "Emotional Intelligence: Why It Can Matter More Than IQ" by Daniel Goleman
6. "Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo
7. "Writing That Works: How to Communicate Effectively in Business" by Kenneth Roman and Joel Raphaelson
8. "Intercultural Communication in Contexts" by Judith N. Martin and Thomas K. Nakayama
9. "The Social Media Bible: Tactics, Tools, and Strategies for Business Success" by Lon Safko

Subject Code	BIT404
Course Name	Brain Computer Interface
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Grasp the fundamental concepts of BCI technology. 2. Familiarise with the integration of BCI technology with IoT devices and systems. 3. Develop skills in signal processing techniques tailored for BCI applications in IoT.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Brain-Computer Interface (BCI): Basic Concepts of BCI, History and Evolution of BCI Technology, Types of BCIs, BCI Applications, Neurophysiology and Brain Signals, Signal Acquisition Methods, Signal Processing Techniques, Ethical Considerations in BCI Research, Future Trends in BCI Technology.	**12**
Unit 2: Brain Signal Acquisition: Electroencephalography (EEG) Signals, Magnetoencephalography (MEG) Signals, Near-Infrared Spectroscopy (NIRS), Invasive Brain Signal Acquisition Methods, Non-invasive Brain Signal Acquisition Methods, Signal Quality Assessment, Artifact Removal Techniques.	**12**
Unit 3: Signal Processing and Feature Extraction: Preprocessing of Brain Signals, Time and Frequency Domain Analysis, Feature Extraction Methods, Spatial Filtering Techniques, Dimensionality Reduction Techniques, Classification Algorithms for Brain Signal Decoding, Performance Evaluation Metrics	**12**
Unit 4: BCI System Design and Implementation: BCI Architecture and Components, Signal Acquisition Hardware and Software, Signal Processing Software and Algorithms, User Interface Design, Real-time BCI System Implementation, BCI System Integration with External Devices, Usability Testing and User Feedback	**12**
Unit 5: Advanced Topics in BCI Research: Brain-Computer Interface Applications in Medicine, Communication, Rehabilitation, Gaming, and Control, Brain-Computer Interface for Assistive Technologies, Brain-Computer Interface for Neurofeedback and Brain Training, Brain-Computer Interface for Augmented and Virtual Reality, Ethical, Legal, and Social Implications of BCI Technology, Emerging Trends and Future Directions in BCI Research	**12**

COURSE OUTCOME
1. Students will be able to demonstrate an understanding of the principles underlying brain-computer interface technology. 2. Students will be able to integrate BCI technology with IoT devices and systems. 3. Students will develop advanced signal processing skills tailored for BCI applications in IoT.

Recommended Readings

1. "Brain-Computer Interfaces: Principles and Practice" by Jonathan Wolpaw and Elizabeth Winter Wolpaw

2. "Brain-Computer Interface Research: A State-of-the-Art Summary" edited by Christoph Guger, Brendan Z. Allison, and Günter Edlinger
3. "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction" by Bernhard Graimann, Brendan Z. Allison, and Gert Pfurtscheller
4. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Aruna Seneviratne
5. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz
6. "The Fourth Industrial Revolution" by Klaus Schwab
7. "Neural Engineering: Computation, Representation, and Dynamics in Neurobiological Systems" by Chris Eliasmith and Charles H. Anderson

Fifth Semester

Subject Code	BIT501
Course Name	Machine Learning in IoT
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Explore advanced ML techniques for IoT, like anomaly detection and clustering. 2. Understand to deploy ML models on IoT devices for real-time decision-making. 3. Evaluate ML model performance in IoT environments.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Machine Learning in IoT - ML fundamentals, IoT applications of ML, Data preprocessing for IoT, Supervised learning in IoT, Unsupervised learning in IoT, Reinforcement learning in IoT, Model evaluation in IoT, ML frameworks for IoT, Edge computing for ML in IoT, Ethics in ML deployment.	**12**
Unit 2: ML Algorithms for IoT Data Analysis - Linear regression, Logistic regression, Decision trees, Random forests, Support vector machines, k-Nearest neighbors, Naive Bayes, Clustering algorithms, Dimensionality reduction techniques, Time series analysis	**12**
Unit 3: Advanced ML Techniques for IoT - Anomaly detection methods, Association rule mining, Recommendation systems, Deep learning architectures, Convolutional neural networks, Recurrent neural networks, Autoencoders, Reinforcement learning algorithms, Transfer learning, Federated learning	**12**
Unit 4: IoT Data Preprocessing and Model Deployment - Data cleaning techniques, Feature engineering methods, Data normalization and scaling, Handling missing data, Model selection and hyperparameter tuning, Model deployment strategies, Containerization for model deployment, IoT edge computing platforms, Real-time inference at the edge, Model monitoring and updating	**12**
Unit 5: Advanced Sensor Network: Sensor node hardware, Sensor node power sources, Sensor node sensors and actuators, Sensor node communication interfaces, Sensor node programming platforms, Sensor node energy harvesting, Sensor node calibration and testing, Sensor node maintenance, Sensor node lifecycle management	**12**

COURSE OUTCOME
1. Explore advanced ML techniques tailored for IoT, such as anomaly detection and clustering. 2. Understand ML principles and their application in IoT contexts. 3. Deploy ML models on IoT devices for real-time decision-making.

Recommended Readings

1. "Hands-On Machine Learning for IoT: Build advanced projects using TensorFlow, Google Cloud Platform, and Docker" by Kai Hwang, Peter H. J. Chong, and Xin Xu.
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.
3. "Machine Learning Yearning: Technical Strategy for AI Engineers, In the Era of Deep Learning" by Andrew Ng.
4. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro.
5. "Machine Learning in Action" by Peter Harrington.

Subject Code	BIT502
Course Name	Mechatronics and Robotics
Credits	4

COURSE OBJECTIVE

After completion of this course, students should be able to:

1. Understand interdisciplinary field of mechatronics and robotics, combining mechanical, electrical, and computer engineering principles.
2. Understand of the fundamental components and systems involved in mechatronic and robotic systems.
3. Develop practical skills in designing, building, and programming mechatronic systems and robots.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Mechatronics and Robotics Overview of mechatronics and robotics, History and evolution, Basic components and systems, Sensors and actuators, Introduction to microcontrollers and embedded systems, Applications of mechatronics and robotics.	**12**
Unit 2: Mechanical Systems and Design Mechanical components and mechanisms, Kinematics and dynamics of robotic systems, Design considerations in mechatronic systems, Material selection and manufacturing processes, Modeling and simulation of mechanical systems.	**12**
Unit 3: Electrical and Electronic Systems Circuit analysis and design, Power electronics, Analog and digital electronics, Control systems fundamentals, PID control, Microcontroller programming, Interfacing sensors and actuators.	**12**
Unit 4: Control Systems and Automation Feedback control systems, Closed-loop control, Control algorithms, Programmable Logic Controllers (PLCs), Industrial automation, Motion control systems, Robotics programming languages.	**12**
Unit 5: Applications and Advanced Topics Industrial robotics applications, Mobile robotics, Autonomous systems, Human-robot interaction, AI and machine learning in robotics, Emerging trends in mechatronics and robotics, Project-based learning and practical applications.	**12**

COURSE OUTCOME

1. Demonstrate proficiency in designing and analyzing mechatronic systems and robotic devices.
2. Apply principles of mechanical, electrical, and computer engineering to develop integrated mechatronic solutions.
3. Utilize sensors, actuators, and control systems to implement intelligent and autonomous robotic systems.

Recommended Readings

1. "Hands-On Machine Learning for IoT: Build advanced projects using TensorFlow, Google Cloud Platform, and Docker" by Kai Hwang, Peter H. J. Chong, and Xin Xu.

2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.
3. "Machine Learning Yearning: Technical Strategy for AI Engineers, In the Era of Deep Learning" by Andrew Ng.
4. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro.

Subject Code	BIT503
Course Name	Web Analytics
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Understand the fundamental concepts and principles of web analytics. 2. Gain proficiency in using web analytics tools for data collection, analysis, and reporting. 3. Develop the skills to analyze web traffic data to extract insights for business decision-making.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to Web Analytics, Key Performance Indicators (KPIs), Data Collection Methods, Web Analytics Tools, Website Metrics, Data Accuracy and Quality, User Engagement Metrics, Bounce Rate Analysis, Click-through Rate (CTR) Analysis, Time on Page Analysis	**12**
Unit 2: Data Analysis Techniques, Data Visualization, Traffic Sources Analysis, User Behavior Analysis, Conversion Rate Optimization, Funnel Analysis, Cohort Analysis, Heatmap Analysis, Scroll Depth Analysis, Form Analytics	**12**
Unit 3: Advanced Analytics Concepts, Segmentation Analysis, A/B Testing, Multivariate Testing, Attribution Modeling, Predictive Analytics, Customer Lifetime Value (CLV) Analysis, Regression Analysis, Time Series Analysis, Correlation Analysis	**12**
Unit 4: Social Media Analytics, Mobile Analytics, E-commerce Analytics, Campaign Tracking, Customer Lifetime Value Analysis, Social Media Engagement Metrics, Mobile App Usage Analysis, Purchase Funnel Analysis, Cart Abandonment Analysis, Return on Investment (ROI) Analysis	**12**
Unit 5: Web Analytics Implementation Strategies, Data Privacy and Security, Reporting and Dashboards, Performance Monitoring, Emerging Trends in Web Analytics, GDPR Compliance, Data Governance Best Practices, Real-time Analytics, Voice Search Analytics, Artificial Intelligence in Analytics	**12**

COURSE OUTCOME
1. Understand web analytics principles and tools for digital marketing. 2. Analyze data to improve website performance and user engagement. 3. Communicate insights effectively through reports and dashboards.

Recommended Readings

1. "Advanced Web Metrics with Google Analytics" by Brian Clifton
2. "Google Analytics Breakthrough: From Zero to Business Impact" by Feras Alhlou, Shiraz Asif, and Eric Fettman
3. "Web Analytics: An Hour a Day" by Avinash Kaushik

Subject Code	BIT504
Course Name	Industrial Internet of Things
Credits	3

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Address IIoT security and interoperability challenges. 2. Explore advanced IIoT technologies. 3. Understand IIoT fundamentals and applications.

Total Number of Lectures: 45

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: IIoT Fundamentals, IIoT Architecture, Sensor Technologies, Industrial Communication Protocols, Data Acquisition and Monitoring, Edge Computing, Fog Computing	**9**
Unit 2: IIoT Applications in Manufacturing, Predictive Maintenance, Asset Tracking, Smart Manufacturing, Quality Control Systems, Remote Monitoring, Industrial Robotics	**9**
Unit 3: IIoT Applications in Energy, Smart Grids, Energy Management Systems, Renewable Energy Integration, Demand Response Systems, Energy Efficiency Monitoring, Grid Optimization	**9**
Unit 4: IIoT Applications in Healthcare, Remote Patient Monitoring, Medical Device Integration, Health Information Systems, Telemedicine, Wearable Health Devices, Patient Data Analytics	**9**
Unit 5: IIoT Applications in Transportation, Connected Vehicles, Intelligent Transportation Systems, Fleet Management, Traffic Control Systems, Autonomous Vehicles, Vehicle-to-Infrastructure Communication	**9**

COURSE OUTCOME
1. Analyze IIoT data for operational improvement. 2. Understand IIoT principles and applications. 3. Explore emerging IIoT trends and innovations.

Recommended Readings

1. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz
2. "Industrial Internet Application Development: Simplify IIoT development using the elasticity of public cloud and native cloud services" by Pradeep Kumar Banerjee
3. "Industrial IoT Strategies: Designing Digital Transformation with the IIoT" by Colin J. Parris, Rob Patterson, Ingo Ramesohl, and Satoshi Konishi
4. "Architecting the Industrial Internet of Things" by Peter M. Martin

Sixth Semester

Subject Code	BIT601
Course Name	Cloud Computing in IoT
Credits	3

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Understand cloud computing fundamentals and key concepts. 2. Develop skills in IoT for cloud environments. 3. Learn to design and manage scalable cloud solutions.

Total Number of Lectures: 45

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Cloud Computing Overview, Cloud Service Models, Cloud Deployment Models, Benefits of Cloud Computing, Cloud Integration with IoT, Cloud-based Data Storage, Cloud-based Data Processing, Security Considerations in Cloud IoT, Case Studies, Cloud IoT Platforms Comparison, Scalability and Elasticity in Cloud Computing	**9**
Unit 2: Cloud Service Providers, IoT Device Setup, Data Storage in Cloud, Data Processing in Cloud, Sensor Integration with Cloud, Security Measures for Cloud IoT, Resource Management in Cloud IoT, Monitoring of Cloud IoT Systems, Optimization Techniques for Cloud IoT, Hybrid Cloud Integration, Edge Computing Solutions for IoT	**9**
Unit 3: Smart Home Automation, Industrial IoT, Healthcare Solutions, Agriculture Monitoring, Transportation Management, Retail Optimization, Energy Grid Solutions, Public Safety Systems, Wearable Health Devices, Smart Cities Initiatives, Environmental Monitoring, Supply Chain Optimization	**9**
Unit 4: App Development for Cloud IoT, Device Provisioning in Cloud, Data Visualization in Cloud, Event-driven Architectures in Cloud IoT, CI/CD Pipelines for Cloud IoT, Testing and Debugging in Cloud IoT, Compliance Considerations for Cloud IoT, Update Management for Cloud IoT, Best Deployment Practices for Cloud IoT, Performance Optimization in Cloud IoT	**9**
Unit 5: Emerging Technologies in Cloud IoT, Edge-to-Cloud Integration, Blockchain in Cloud IoT, AI and Edge Computing in Cloud IoT, Quantum Computing in Cloud IoT, Privacy and Ethics in Cloud IoT, Interoperability Challenges in Cloud IoT, Sustainability in Cloud IoT, Security Concerns in Cloud IoT, Research Opportunities in Cloud IoT	**9**

COURSE OUTCOME
1. Understand the fundamental concepts and principles of cloud computing. 2. Develop skills in cloud management, optimization, and cost control. 3. Collaborate effectively with teams to deploy and manage cloud-based solutions.

Recommended Readings

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood
2. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J. Kavis
3. "AWS Certified Solutions Architect Study Guide: Associate SAA-C01 Exam" by Ben Piper, David Clinton
4. "Google Cloud Platform in Action" by JJ Geewax
5. "Azure for Architects: Implementing Cloud Design, DevOps, IoT, and Serverless Solutions on Your Public Cloud" by Ritesh Modi

Subject Code	BIT602N
Course Name	Employability & Practitioner Skills
Credits	4

COURSE OBJECTIVE
After completion of this course, students should be able to: 1. Enhancing communication, critical thinking, and teamwork skills. 2. Cultivating time management, adaptability, and professional ethics. 3. Acquiring industry-relevant knowledge and practical skills.

Total Number of Lectures: 60

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Professional Communication Skills, Interview Preparation Techniques, Resume Writing Strategies, Networking Skills, Presentation Skills, Effective Email Communication, Assertiveness Training	**12**
Unit 2: Time Management Strategies, Goal Setting Techniques, Problem-solving Skills, Decision-making Strategies, Stress Management Techniques, Procrastination Management, Task Prioritization Methods	**12**
Unit 3: Teamwork and Collaboration Skills, Conflict Resolution Techniques, Leadership Skills, Delegation Strategies, Motivation Techniques, Building Trust in Teams, Cross-cultural Communication	**12**
Unit 4: Adaptability and Flexibility, Creativity and Innovation Skills, Critical Thinking Skills, Emotional Intelligence, Cultural Sensitivity, Resilience Building, Adaptive Problem-solving	**12**
Unit 5: Business Etiquette and Professionalism, Workplace Ethics, Career Planning and Development, Entrepreneurial Skills, Industry Trends and Insights, Personal Branding Strategies, Networking in the Digital Age	**12**

COURSE OUTCOME
1. Develop proficient communication skills in various contexts. 2. Adapt effective problem-solving and critical thinking abilities. 3. Cultivate strong teamwork and collaboration capabilities.

Recommended Readings

1. "How to Win Friends and Influence People" by Dale Carnegie
2. "Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler
3. "The 7 Habits of Highly Effective People" by Stephen R. Covey
4. "Mindset: The New Psychology of Success" by Carol S. Dweck
6. "Emotional Intelligence 2.0" by Travis Bradberry and Jean Greaves