R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE – Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR-Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Mathematical Foundation of Information Security	IOT-3011	3L-1T-0P	4

Course Outcomes:

CO1 Understand and apply number theory concepts such as modular arithmetic, prime numbers, and Euler's theorem in cryptographic applications.

CO2 Analyze and design symmetric and asymmetric encryption schemes using mathematical principles.

CO3 Apply group theory and finite fields to cryptographic algorithms like AES and Elliptic Curve Cryptography.

CO4 Understand probabilistic models and complexity theory concepts relevant to cryptographic security.

CO5 Evaluate security protocols using formal mathematical approaches and determine their strengths and weaknesses.

Course Contents:

UNIT I

Number Theory for Cryptography: Basics of divisibility and division algorithm, primes numbers, Modular arithmetic, GCD, Euclidean algorithm, Euler's phi function, Fermat's and Euler's theorems, Euler's totient function $\varphi(n)$ and its properties, Modular exponentiation, Chinese remainder theorem, primality tests, Applications in Diffie-Hellman, RSA

UNIT II

Algebraic Structures: Groups, Rings, and Fields, Finite fields, Galois Fields – GF(p), GF(2^n), Polynomial arithmetic, Applications to AES and error-correcting codes, cryptanalysis

UNIT III

Symmetric Cryptography: Principles of block and stream ciphers, Confusion and Diffusion, Substitution-Permutation Networks, Mathematical design of DES and AES, Feistel network structure, Modes of operation, Mathematical structure in S-Boxes and MixColumns, Key schedules and security properties

UNIT IV

Asymmetric Cryptography: Public-key cryptography overview, key generation, encryption/decryption, security, ElGamal encryption, Discrete logarithm problem, Elliptic Curve Cryptography over finite fields

UNIT V

Probability and Information Theory: Basic probability concepts, Entropy, mutual information, Perfect secrecy and Shannon's theory, One-time pad, Introduction to randomness and pseudorandomness, Hardness assumptions in cryptography, Hash functions and collision resistance, Merkle-Damgård construction, Birthday Paradox and its application to collision finding, Digital signatures and zero-knowledge proofs

References:

1. Cryptography and Network Security - Principles and Practice, 7e, by Stallings William, Pearson Education
2. Cryptography And Network Security, 3e by Behrouz A. Forouzan and Debdeep Mukhopadhyay, McGraw Hill Education
3. Modern Cryptography Volume 1: A Classical Introduction to Informational and Mathematical Principle, by Zhiyong Zheng, Springer
4. An Introduction to Mathematical Cryptography, 2e, by Jeffrey Hoffstein, Jill Pipher and Joseph H. Silverman, Springer
5. A Friendly Introduction to Number Theory, 4e, by Joseph H. Silverman, Pearson Education
6. Cryptography Made Simple, by Nigel Smart, Springer
7. A Classical Introduction to Cryptography: Applications for Communications Security, by Serge Vaudenay, Springer
8. Understanding Cryptography: A Textbook for Students and Practitioners, by Christof Paar and Jan Pelzl, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Data structure & Algorithms	IOT-3021	3L-1T-2P	6

Course Outcomes:

CO1 Understand the concept of Dynamic memory management, data types, algorithms, Big O notation.

CO2 Understand basic data structures such as arrays, linked lists, stacks and queues.

CO3 Describe the hash function and concepts of collision and its resolution methods

CO4 Solve problem involving graphs, trees and heaps.

CO5 Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data

Course Contents:

UNIT I

Introduction: to Notions of data type, abstract data type, and data structures, Relation to the notion of classes and objects in object oriented programming, Importance of algorithms and data structures in programming, Notion of Complexity covering time complexity and space complexity, Worst case complexity, Average case complexity, Big O Notation, Examples of simple algorithms and illustration of their complexity, Introduction to recurrence relations, Iteration and Recursion - Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers, Tradeoffs between iteration and recursion

UNIT- II

List ADT, Implementation of lists using arrays and pointers, Stack ADT, Queue ADT, Implementation of stacks and queues, Dictionaries, Hash tables: open tables and closed tables. Analysis of hashing, Skip lists and analysis

UNIT- III

Binary Trees- Definition and traversals: preorder, postorder, inorder, Common types and properties of binary trees, Counting of binary trees, Huffman coding using binary trees, Binary search trees: worst case analysis and average case analysis. AVL trees, Red-Black Trees, Splay trees, Priority Queues - Binary heaps: insert and delete min operations and analysis. Binomial queues

UNIT- IV

Directed Graphs - Data structures for graph representation, Shortest path algorithms: Dijkstra (greedy algorithm) and Bellman-Ford (dynamic programming), Depth- first search and Breadth-first search. Directed acyclic graphs, Undirected Graphs - Depth-first search and breadth-first search, Minimal spanning trees and algorithms (Floyd and Kruskal) and implementation, Application to the travelling salesman problem

UNIT- V

Sorting- Bubblesort, selection sort, insertion sort, Shell sort; Quicksort; Heapsort; Mergesort; Radix sort; Analysis of the sorting methods. Selecting the top k elements, Lower bound on sorting

References:

1. Classic Data Structures, by Debasis Sumanta, PHI Learning Private Limited
2. Data Structures and Algorithms, by Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft, Addison- Wesley Series
3. Schaum's Outline of Data Structures, by Seymour Lipschutz, Tata McGraw Hill Education
4. Data Structures And Algorithms Made Easy, by Narasimha Karumanchi, Careermonk Publications
5. Data Structures and Algorithms in Python, by Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, Wiley
6. Fundamentals of Data Structures in C, 2e, by Sahni Horowitz, University Press
7. Data Structures Through C in Depth, by S.K.Srivastava and Deepali Srivastava, BPB Publications
8. Data Structures and Algorithms, by Reema Thareja, Oxford University Press
9. Data Structures Using C, by E. Balagurusamy, McGraw Hill Education
10. Data Structures, 2e, by R. Venkatesan and S. Lovelyn Rose, Wiley
11. Data Structures Through C, by Yashavant Kanetkar, BPB Publications

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Computer Organization & Architecture	IOT-3031	3L-1T-0P	4

Course Outcomes:

CO1 Explain the organization of basic computer, its design and the design of control unit.

CO2 Understand basic data structures such as arrays, linked lists, stacks and queues.

CO3 Describe the operations and language of the register transfer, micro operations and input-output organization.

CO4 Understand the organization of memory and memory management hardware.

CO5 Elaborate advanced concepts of computer architecture, Parallel Processing, interprocessor communication and synchronization.

Course Contents:

UNIT I

Basic Structure of Computers

Functional units - Basic operational concepts - Bus structures - Software performance – Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Basic I/O operations – Stacks and queues.

UNIT II

Arithmetic Unit

Addition and subtraction of signed numbers – Design of fast adders – Multiplication of positive numbers - Signed operand multiplication and fast multiplication – Integer division – Floating point numbers and operations.

UNIT III

Basic Processing Unit

Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control – Microprogrammed control - Pipelining – Basic concepts – Data hazards – Instruction hazards – Influence on Instruction sets – Data path and control consideration – Superscalar operation.

UNIT IV

Memory System

Basic concepts – Semiconductor RAMs - ROMs – Speed - size and cost – Cache memories - Performance consideration – Virtual memory- Memory Management requirements – Secondary storage

UNIT V

I/O Organization

Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface circuits – Standard I/O Interfaces (PCI, SCSI, USB)

References:

1. Computer System Architecture, 3e, by M. Morris Mano, Pearson Education
2. Computer Organization and Architecture - Designing for Performance, 11e, by William Stallings, Pearson Education
3. Computer Architecture and Organisation: Schaum's Outlines Series, by Nicholas P. Carter, Raj Kamal, McGraw Hill Education
4. Computer Organization 5e, by Carl Hamacher, Zvonko Vranesic and Safwat Zaky, McGraw Hill Education
5. Computer Architecture and Organization, by John P. Hayes, McGraw Hill Education
6. Computer Organization and Design: The hardware/Software Interface, by David A. Patterson and John L. Hennessy, Morgan Kaufmann

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SECOND YEAR, Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Digital Circuit and System	IOT-3041	3L-1T-2P	6

Course Outcomes:

CO1 Develop a digital logic and apply it to solve real life problems.

CO2 Analyze, design and implement combinational logic circuits.

CO3 Classify different semiconductor memories.

CO4 Analyze, design and implement sequential logic circuits

Course Contents:

UNIT I

Digital Fundamentals

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization

UNIT II

Combinational Circuit Design

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder

UNIT III

Synchronous Sequential Circuits

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register

UNIT IV

Asynchronous Sequential Circuits

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits

UNIT V

Memory Devices and Digital Integrated Circuits

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

References:

1. Digital Logic and Computer Design By M. Morris Mano
2. Digital Circuits and Design 5e, By S. Salivahanan and S. Arivazhagan, Oxford University Press
3. Fundamentals of Digital 4e, by A. Anand Kumar, PHI Learning Private Limited
4. Digital Principles and Applications, 6e, by Donald P.Leach and Albert Paul Malvino, McGraw Hill Education
5. Digital Design, Principles and Practices, by John. F. Wakerly, Pearson Education
6. Digital Logic Applications and Design, by John.M Yarbrough, Thomson Learning

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Value Education	IOT-3051	3L-1T-2P	6

Course Outcomes:

CO1 To learn the philosophy of Life, personal value, social value, mind cultural value and personal health.

CO2 To learn professional ethical values, codes of ethics, responsibilities, safety, rights and related Global issues.

CO3 To know self-esteem, self-understanding, self-awareness.

CO4 To developing a social relationship.

Course Contents:

Chapter 1

Concepts of Values-Definition and Types of values –The need for Education in values-Challenges for Value adoption-Character development-Vision of a better world

Chapter 2

Inculcation of values
Classification of values- Personal Values-Family Values-Social Values-Spiritual values-Benefits of value adoption

Chapter 3

Values for Professional excellence
Definition-Purpose-implementation-situations to adopt-reflection questions-quotable quotes of Active listening-Decision making-Determination-Perseverance-Discipline-Responsibility

Chapter 4

Business ethics
Ethics and Entrepreneurship- Professional Ethics –Ethical choices- Resolving Ethical Dilemmas-Leadership and Social Responsibility- Corporate Social Responsibility

Chapter 5

Quality of Life
Dealing with change-Trends, Organizations and the Individual-Self and the world-Quality from within-Relating to others-The dynamics of personal powers

Chapter 6

Exploring the self
True Identity-Anatomy of the self-The cyclic processes within the self-States of the awareness-Innate and Acquired qualities-Empowering the

Chapter 7

Understanding Self-Esteem
Know self-esteem-Understanding the self-Components of self-esteem-Association with self-esteem-Levels of self-esteem-Reflection exercises

Chapter 8

Principles of living
Be introspective-Be an observer-Being optimistic - Appreciate differences - Don’t compare yourself with others-Live at present

Chapter 9

Practical Meditation
Why meditate? - Soul consciousness-The supreme-Karma-Timeless dimension-The eight powers

Chapter 10

Exercises for Practice
Quiet reflection- Practice introversion - Being an observer-Stand back and observe – Self-awareness (Soul consciousness) - Experiencing Body free stage-Reflect on original qualities - Visualize the Divine-Think attributes of the Supreme-Developing a living relationship-Surrender to God-Create Good wishes for all- Visualization in Meditation: Orbs of Light- The forest-The Balloon.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Software Lab 1 (C++)	IOT-3061	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Introduces Object Oriented Programming concepts using the C++ language.

CO2 Introduces the principles of data abstraction, inheritance and polymorphism.

CO3 Introduces the principles of virtual functions and polymorphism.

CO4 Introduces handling formatted I/O and unformatted I/O.

CO5 Introduces exception handling.

Course Contents:

UNIT I

Object-Oriented Thinking: Different paradigms for problem solving, need for OOP paradigm, differences between OOP and Procedure oriented programming, Overview of OOP concepts-Abstraction, Encapsulation, Inheritance and Polymorphism. C++ Basics: Structure of a C++ program, Data types, Declaration of variables, Expressions, Operators, Operator Precedence, Evaluation of expressions, Type conversions, Pointers, Arrays, Pointers and Arrays, Strings, Structures, References. Flow control statement-if, switch, while, for, do, break, continue, goto statements. Functions -Scope of variables, Parameter passing, Default arguments, inline functions, Recursive functions, Pointers to functions. Dynamic memory allocation and de-allocation operators - new and delete, Preprocessor directives.

UNIT –II

C++ Classes and Data Abstraction: Class definition, Class structure, Class objects, Class scope, this pointer, Friends to a class, Static class members, Constant member functions, Constructors and Destructors, Dynamic creation and destruction of objects, Data abstraction, ADT and information hiding.

UNIT –III

Inheritance: Defining a class hierarchy, Different forms of inheritance, Defining the Base and Derived classes, Access to the base class members, Base and Derived class construction, Destructors, Virtual base class. Virtual Functions and Polymorphism: Static and Dynamic binding, virtual functions,

Dynamic binding through virtual functions, Virtual function call mechanism, Pure virtual functions, Abstract classes, Implications of polymorphic use of classes, Virtual destructors.

UNIT –IV

C++ I/O: I/O using C functions, Stream classes hierarchy, Stream I/O, File streams and String streams, Overloading operators, Error handling during file operations, Formatted I/O.

UNIT-V

Exception Handling: Benefits of exception handling, Throwing an exception, The try block, Catching an exception, Exception objects, Exception specifications, Stack unwinding, Rethrowing an exception, Catching all exceptions.

References:

1. C++ The Complete Reference, 4e, Herbert Schildt, Tata McGraw Hill
2. Problem solving with C++: The Object of Programming, 4e, Walter Savitch, Pearson Education
3. The C++ Programming Language, 3e, Bjarne Stroustrup, Pearson Education
4. Object Oriented Programming in C++, 3e, Robert Lafore, Galogotia Publications Pvt Ltd
5. Object Oriented Programming with C++, E. Balagurusamy, Tata McGraw Hill
6. Object Oriented Programming with C++, David Parsons, BPB Publications

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Environmental Engineering	IOT-4011	4L-0T-0P	4

Course Outcomes: After studying this course, students will be able to,

CO1-Convey a clear idea of use of renewable and non-renewable energy sources, its impact on environment. The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk and its effect on ecosystem.
CO2-Ability to understand environmental laws and regulations to develop guidelines, procedures and processes for health and safety issues due to air pollution and sound pollution.
CO3-Ability to understand environmental laws and regulations to develop guidelines, procedures and processes for health and safety issues due to water pollution
CO4-Understand what are professional ethics and how do ethics affect the outcomes of environmental laws and regulations.
CO5-Understanding the basic and causes of climate and weather change, global warming, climate variability

Unit –I

Energy- Sources of Energy : Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydal, nuclear sources.
Ecosystem – Segments of Environment: Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation,

Unit –II

Air Pollution & Sound Pollution - Air Pollution: Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Green house effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

Unit –III

Water Pollution– Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent.
Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

Unit –IV

Society, Ethics & Human values– Impact of waste on society. Solid waste management (Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, objectives of ethics and its study . Preliminary studies regarding Environmental Protection Acts , introduction to value education, self exploration, sanyam & swasthya.

Unit –V

Basics of climate and weather, global warming, climate variability;
Causes of climate change – natural and anthropogenic, greenhouse gases, carbon cycle;

Mitigation strategies – renewable energy, energy efficiency, afforestation and reforestation, carbon capture utilization and storage (CCUS), sustainable practices;
Adaptation strategies – climate-resilient infrastructure, agriculture adaptation, water management, disaster risk reduction;
Policies and global efforts – UNFCCC, IPCC, COP summits, Paris Agreement, Kyoto Protocol;
India's initiatives – National Action Plan on Climate Change (NAPCC), State Action Plans on Climate Change (SAPCC), green economy measures;
Sustainable Development Goals (SDGs) and climate action.

References:-

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House.
7. Bala Krishnamoorthy; "Environmental management"; PHI
8. Gerard Kiely, "Environmental Engineering" ; TMH
9. Miller GT JR; living in the Environment Thomson/cengage
10. Cunninghan WP and MA; principles of Environment Sc; TMH
11. Pandey, S.N. & Mishra, S.P. Environment & Ecology, 2011, Ane Books , Pvt. Ltd, New Delhi
12. Joseph, B. Environmental Studies, 2009 Tata Mcgraw Hill, Edu India Ltd. New Delhi.
13. Gour R.R, Sangal, R &Bagaria, G.P. , Excel Books, A-45, Naraina Pilovepdf_merged.pdfPage 118hase-I ,New Delhi.- 110028

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Database Management System	IOT-4021	4L-0T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand database concepts and structures and query language.

CO2 Understand the E-R model and relational model.

CO3 To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

CO4 Understand Functional Dependency and Functional Decomposition.

CO5 Apply various Normalization techniques.

Course Contents:

UNIT I

Introduction And Conceptual Modeling: Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model – Relational Model – Relational Algebra and Calculus.

UNIT II

Relational Model: SQL – Data definition- Queries in SQL- Updates- Views – Integrity and Security – Relational Database design – Functional dependencies and Normalization for Relational Databases (up to BCNF).

UNIT III

Data Storage and Query Processing: Record storage and Primary file organization- Secondary storage Devices- Operations on Files- Heap File- Sorted Files- Hashing Techniques – Index Structure for files – Different types of Indexes-B-Tree - B+ Tree – Query Processing.

UNIT IV

Transaction Management: Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability- Serializability and Schedules – Concurrency Control – Types of Locks- Two Phases locking- Deadlock- Time stamp-based

concurrency control – Recovery Techniques – Concepts- Immediate Update- Deferred Update - Shadow Paging.

UNIT V

Current Trends: Object Oriented Databases – Need for Complex Data types- OO data Model- Nested relations- Complex Types- Inheritance Reference Types - Distributed databases- Homogenous and Heterogenous - Distributed data Storage – XML – Structure of XML- Data- XML Document- Schema- Querying and Transformation. – Data Mining and Data Warehousing.

References:

1. Database System Concepts, 4e, by Abraham Silberschatz, Henry F. Korth and S. Sudarshan, McGraw Hill Education
2. Database Management System, Raghu Ramakrishnan, Tata McGraw-Hill Education
3. Fundamental Database Systems 3e. by Ramez Elmasri and Shamkant B. Navathe, Pearson Education
4. An Introduction to Database Systems, 8e by CJ Date, Pearson Education
5. Database Systems: A Practical Approach to Design, Implementation and Management, 4e, by Thomas M. Connolly, Carolyn Begg, Pearson Education
6. Schaum's Outline of Fundamentals of Relational Databases by Ramon Mata-Toledo, Pauline Cushman, McGraw Hill Education

DBMS Lab (List of Experiments):

1. Data Definition Language (DDL) commands in RDBMS.
2. Data Manipulation Language (DML) and Data Control Language (DCL) commands in RDBMS.
3. High-level language extension with Cursors.
4. High level language extension with Triggers
5. Procedures and Functions.
6. Embedded SQL.
7. Database design using E-R model and Normalization.
8. Design and implementation of Payroll Processing System.
9. Design and implementation of Banking System.
10. Design and implementation of Library Information System.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Artificial Intelligence	IOT-4031	3L-1T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Acquire the knowledge of basic artificial intelligence.

CO2 Acquire the knowledge of searching strategies of AI.

CO3 Acquire the knowledge of game playing techniques and planning of AI.

CO4 Understand the concept of statistical methods for reasoning and logic.

CO5 Acquire the knowledge of expert systems and other learning methods of AI.

Course Contents:

UNIT I

Introduction: Introduction to Artificial Intelligence (AI), Foundations of AI, History of AI, Real life examples of AI, Turing test for AI, AI techniques, Problem Solving- Formulating problems, problem types, states and operators, state space.

UNIT II

Search Techniques in AI: Search algorithms in AI, Types of AI search, Uninformed search, Informed search, heuristic functions, Depth first search, Breadth first search, Best first search, Hill climbing algorithm, A* algorithm, AO* algorithm, Iterative deepening A*(IDA), small memory A*(SMA).

UNIT III

Game Playing and Planning: Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning, Minimax search, Planning, Components of planning, Goal stack planning, partial order planning, planning in the blocks world, hierarchical planning, conditional planning.

UNIT IV

Reasoning and Logic: Probability and Bayes' Theorem, Bayesian networks, Dempster-Shafer theory, Representation, Inference, Propositional Logic, predicate logic (first order logic), logical reasoning, forward chaining, backward chaining.

UNIT V

Expert Systems and Other Learning Methods: Representation, Expert system shells, Knowledge acquisition, neural networks, reinforcement learning, genetic algorithm, natural language processing.

References:

1. Artificial Intelligence 3e by Elaine Rich, Kevin Knight, Shivashankar B Nair, Tata McGraw Hill
2. Artificial Intelligence A Modern Approach by Stuart Russell, Peter Norvig, Prentice Hall Series
3. A First Course in Artificial Intelligence by Deepak Khemani, Tata McGraw Hill
4. Grokking Artificial Intelligence Algorithms by RishalHurbans, Manning Pub.
5. Artificial Intelligence: Concepts and Applications, by Lavika Goel, Wiley
6. Artificial Intelligence for Dummies, by John Paul Mueller and Luca Massaron, Wiley
7. Fundamentals of Artificial Intelligence by K.R. Chowdhary, Springer
8. Artificial Intelligence, 3e, by Patrick Henry Winston, Pearson Education
9. Artificial Intelligence: Beyond Classical AI by Reema Thareja, Pearson Education

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SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Design and Analysis of Algorithm	IOT-4041	3L-1T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Analyze the asymptotic performance of algorithms.

CO2 Write rigorous correctness proofs for algorithms

CO3 Demonstrate a familiarity with major algorithms and data structures.

CO4 Apply important algorithmic design paradigms and methods of analysis.

CO5 Synthesize efficient algorithms in common engineering design situations.

Course Contents:

UNIT I

BASIC CONCEPTS OF ALGORITHMS

Introduction – Notion of Algorithm – Fundamentals of Algorithmic Solving – Important Problem types – Fundamentals of the Analysis Framework – Asymptotic Notations and Basic Efficiency Classes.

UNIT II

MATHEMATICAL ASPECTS AND ANALYSIS OF ALGORITHMS

Mathematical Analysis of Non-recursive Algorithm – Mathematical Analysis of Recursive Algorithm– Example: Fibonacci Numbers – Empirical Analysis of Algorithms – Algorithm Visualization.

UNIT III

ANALYSIS OF SORTING AND SEARCHING ALGORITHMS

Brute Force – Selection Sort and Bubble Sort – Sequential Search and Brute-force string matching– Divide and conquer – Merge sort – Quick Sort – Binary Search – Binary tree- Traversal and Related Properties – Decrease and Conquer – Insertion Sort – Depth first Search and Breadth First Search.

UNIT IV

ALGORITHMIC TECHNIQUES

Transform and conquer – Presorting – Balanced Search trees – AVL Trees – Heaps and Heap sort – Dynamic Programming – Warshall's and Floyd's Algorithm – Optimal Binary Search trees– Greedy Techniques – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman trees.

UNIT V

ALGORITHM DESIGN METHODS

Backtracking – n-Queen's Problem – Hamiltonian Circuit problem – Subset-Sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.

References:

1. Introduction to Algorithms 2e, by T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, PHI Pvt. Ltd.
2. Fundamentals of Computer Algorithms by Sartaj Sahni, Sanguthevar Rajasekaran and Ellis Horowitz, University Press
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia,
4. Sara Baase and Allen Van Gelder, "Computer Algorithms - Introduction to Design and Analysis",

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SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Computer Network	IOT-4051	3L-1T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand and describe the layered protocol model.

CO2 Understand and explain data communications System and its components

CO3 Identify the different types of network topologies and protocols.

CO4 Identify the different types of network devices and their functions within a network.

CO5 Understand and building the skills of subnetting and routing mechanisms.

Course Contents:

UNIT I

DATA COMMUNICATIONS

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences.

UNIT II

DATA LINK LAYER

Error – detection and correction – Parity – LRC – CRC – Hamming code – low Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ- sliding window – HDLC. - LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges.

UNIT III

NETWORK LAYER

Internetworks – Packet Switching and Datagram approach – IP addressing methods – Subnetting– Routing – Distance Vector Routing – Link State Routing – Routers.

UNIT IV

TRANSPORT LAYER

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.

UNIT V

APPLICATION LAYER

Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW – Security – Cryptography.

References:

1. Computer Networks, 2e, by Andrew S. Tanenbaum, Pearson Education
2. Data Communication and Networking 2e, by Behrouz A. Forouzan, Tata McGraw-Hill
3. Data and Computer Communications 10e, by William Stallings, Pearson Education
4. Computer Networking: A Top-Down Approach Featuring the Internet, by James F. Kurose and Keith W. Ross, Pearson Education
5. Computer Networks 2e by Larry L. Peterson and Peter S. Davie, Harcourt Asia Pvt. Ltd.

NETWORKING LAB LIST OF EXPERIMENTS

All the programs are to be written using C:

1. Simulation of ARP / RARP.
2. Write a program that takes a binary file as input and performs bit stuffing and CRC Computation.
3. Develop an application for transferring files over RS232.
4. Simulation of Sliding-Window protocol.
5. Simulation of BGP / OSPF routing protocol.
6. Develop a Client – Server application for chat.
7. Develop a Client that contacts a given DNS Server to resolve a given host name.
8. Write a Client to download a file from a HTTP Server.
9. Study of Network Simulators like NS2/Glomosim / OPNET

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
SECOND YEAR, Semester – IV
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Software Lab-II (Wireshark)	IOT-4061	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Explain the role and functionality of network analysis tools, particularly Wireshark.

CO2 Capture and filter real-time network traffic using Wireshark.

CO3 Analyze different network protocols (Ethernet, IP, TCP, UDP, HTTP, DNS, etc.).

CO4 Diagnose network performance issues and security vulnerabilities using packet analysis.

CO5 Apply protocol analysis techniques to troubleshoot real-world network problems.

Course Contents:

UNIT I

Introduction to Network Analysis: Purpose and importance of network analysis, Overview of Wireshark and alternatives (tcpdump, tshark), Installation and setup of Wireshark, Legal and ethical considerations in packet capturing

UNIT II

Capturing Network Traffic: Live packet capture with Wireshark, Selecting appropriate network interfaces, Capture filters vs. display filters, Saving and exporting capture files (.pcap) Analyzing Protocols: Ethernet frame analysis, IP addressing and packet structure, TCP/UDP header analysis (ports, flags, sequence/ack numbers), HTTP, DNS, FTP, DHCP traffic analysis

UNIT III

Troubleshooting Network Issues: Detecting latency, retransmissions, and dropped packets, Identifying bandwidth hogs and misconfigured hosts, Analyzing client-server interactions, Common case studies in LAN/WAN environments

UNIT IV

Security and Threat Detection: Detecting suspicious activity (port scans, ARP spoofing), Analyzing malware behavior and command and control traffic, Using Wireshark in incident response, Decrypting SSL/TLS (if keys are available)

UNIT V

Advanced Wireshark Features: Creating custom profiles and coloring rules, Graphs, flow diagrams, and IO statistics, Integration with external tools (Snort, Suricata), Scripting with tshark and automation

References:

1. Ethical Hacking and Network Analysis with Wireshark: Exploration of network packets for detecting exploits and malware, by Manish Sharma, BPB Publications
2. Learn Wireshark: A definitive guide to expertly analyzing protocols and troubleshooting networks using Wireshark, by Lisa Bock, Packt Publishing Limited
3. Tactical Wireshark: A Deep Dive into Intrusion Analysis, Malware Incidents, and Extraction of Forensic Evidence, by Kevin Cardwell, Apress
4. Wireshark Essentials: Get Up and Running With Wireshark to Analyze Network Packets and Protocols Effectively, by James H. Baxter, Packt Publishing Limited
5. Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems, 3e, by Chris Sanders, No Starch Press
6. Wireshark Essentials: Simplifying Network Security and Troubleshooting, by Arun Soni, CRC Press

List of Experiments to be perform (Expandable)

1. Installing Wireshark in Windows, macOS, Linux
2. Capturing live traffic or using provided trace files.
3. Applying filters (e.g., http, dns, tcp.port == 80) to isolate packets.
4. Examining protocol fields like headers, payloads, and message exchanges.
5. Analyze HTTP GET/POST requests and responses, including headers and object retrieval. Use filters like http.request.method == "GET". Understand web protocol mechanics, caching, and conditional requests.
6. Capture DNS queries/responses for domain resolution. Examine query types (A, NS, MX) and iterative/recursive resolution. Explore name resolution process and DNS message structure
7. Examine TCP three-way handshake, segment structure, sequence/ACK numbers, and congestion control. Use traces to simulate connection setup/teardown. Dive into reliable transport, flow control, and error recovery.
8. Compare UDP with TCP by capturing datagram exchanges (e.g., DNS over UDP). Analyze header fields and lack of reliability. Highlight differences in connectionless vs. connection-oriented transport.
9. Observe TCP window scaling, slow-start, and congestion avoidance in file downloads. Plot throughput vs. time. Understand how TCP adapts to network load and avoids congestion collapse.
10. Inspect IPv4/IPv6 headers, fragmentation, and routing. Capture pings to see ICMP echoes. Analyze datagram delivery, addressing, and fragmentation/reassembly.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Operating Systems	IOT-5011	4L-0T-2P	6

Course Outcomes:

CO1 Understand the basics of operating systems like kernel, shell, types and views of operating systems.

CO2 Describe the various CPU scheduling algorithms and remove deadlocks.

CO3 Explain various memory management techniques and concept of thrashing.

CO4 Use disk management and disk scheduling algorithms for better utilization of external memory.

CO5 Recognize file system interface, protection and security mechanisms.

Course Contents:

UNIT I

INTRODUCTION

Introduction - Mainframe systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems – Real Time Systems – Handheld Systems - Hardware Protection – System Components – Operating System Services – System Calls – System Programs - Process Concept – Process Scheduling – Operations on Processes – Cooperating Processes – Inter- process Communication.

UNIT II

SCHEDULING

Threads – Overview – Threading issues - CPU Scheduling – Basic Concepts – Scheduling Criteria– Scheduling Algorithms – Multiple-Processor Scheduling – Real Time Scheduling - The Critical-Section Problem – Synchronization Hardware – Semaphores – Classic problems of Synchronization– Critical regions– Monitors.

UNIT III

DEADLOCKS

System Model – Deadlock Characterization – Methods for handling Deadlocks -Deadlock Prevention– Deadlock avoidance – Deadlock detection – Recovery from Deadlocks - Storage Management– Swapping – Contiguous Memory allocation – Paging – Segmentation – Segmentation with Paging.

UNIT IV

PAGING AND FILE SYSTEM

Virtual Memory – Demand Paging – Process creation – Page Replacement – Allocation of frames– Thrashing - File Concept – Access Methods – Directory Structure – File System Mounting – File Sharing – Protection

UNIT V

FILE MANAGEMENT

File System Structure – File System Implementation – Directory Implementation – Allocation Methods – Free-space Management. Kernel I/O Subsystems - Disk Structure – Disk Scheduling – Disk Management – Swap-Space Management. Case Study: The Linux System, Windows

References:

1. Operating System Concepts, by Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, John Wiley & Sons
2. Operating Systems 2e, by Harvey M. Deitel, Pearson Education
3. Modern Operating Systems, by Andrew S. Tanenbaum, Pearson Education
4. Operating Systems Internal and Design, by William Stallings, Pearson Education
5. Operating System Design: The Xinu Approach, 2e, by Douglas E. Comer, CRC Press

List of Experiment

1. Write a program to implement FCFS CPU scheduling algorithm.
2. Write a program to implement SJF CPU scheduling algorithm.
3. Write a program to implement Priority CPU Scheduling algorithm.
4. Write a program to implement Round Robin CPU scheduling algorithm.
5. Write a program to compare various CPU Scheduling Algorithms over different Scheduling Criteria.
6. Write a program to implement classical inter process communication problem.
7. Write a program to implement classical inter process communication problem.
8. Write a program to implement classical inter process communication problem.
9. Write a program to implement & Compare various page replacement algorithms.
10. Write a program to implement & Compare various Disk & Drum scheduling Algorithms.
11. Write a program to implement Banker’s algorithms.
12. Write a program to implement Remote Procedure Call (RPC).
13. Write a Devices Drivers for any Device or peripheral.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Wireless Sensor Networks	IOT-5021	3L-1T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand WSN architecture and components.

CO2 Learn various communication protocols and standards.

CO3 Study data aggregation, routing, localization, and synchronization techniques.

CO4 Analyze performance and energy-efficiency issues.

CO5 Explore real-world applications and challenges in WSN deployment.

Course Contents:

UNIT I

Introduction to Wireless Sensor Network:
Definition and Overview, Applications: Environmental Monitoring, Health, Military, Smart Cities, Components: Sensors, Actuators, Nodes, Architecture, WSN Architecture and Platforms, Hardware and Sensor Node Architecture Motes (TelosB, MicaZ, etc.), Operating Systems for WSN (TinyOS, Contiki)

UNIT II

Wireless Communication in WSN:
Radio Propagation, Modulation and Signal Processing, MAC Protocols (TDMA, CSMA, S-MAC, T-MAC), Routing in WSN, Flat, Hierarchical, and Location-Based Routing, Directed Diffusion, Routing Algorithms - LEACH, PEGASIS, GEAR.

UNIT III

Data Aggregation and Compression:
Data-centric Routing, In-network Processing, Compression Techniques, Localization and Synchronization, Localization Techniques (GPS-free), Time Synchronization Protocols - Reference Broadcast Synchronization (RBS), Timing-sync Protocol for Sensor Network (TPSN)

UNIT IV

Energy Efficiency and Power Management:

Sources of Power Consumption, Sleep Scheduling and Energy Harvesting, Duty Cycling, Security in WSN, Threat Models, Secure Routing, Cryptography in Resource-Constrained Devices

UNIT V

Simulation and Tools:

OMNeT++, Cooja, TOSSIM, Practical Case Studies and Simulations, Module 10: Advanced Topics and Applications, Internet of Things (IoT) and WSN Integration, WSN in Industrial Automation, Smart Agriculture and Smart Homes

References:

1. Protocols and Architectures for Wireless Sensor Networks, by Holger Karl and Andreas Willig, Wiley
2. Wireless Sensor Networks: An Information Processing Approach, by Feng Zhao and Leonidas Guibas, Morgan Kaufmann (Elsevier)
3. Wireless Sensor Networks - Signal Processing and Communications Perspectives, by Lang Tong Ananthram Swami, Qing Zhao, and Yao-Win Hong, Wiley
4. Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing, by Robert Faludi, O'Reilly Media
5. Fundamentals of Wireless Sensor Networks: Theory and Practice, by Waltenegus Dargie and Christian Poellabauer, Wiley
6. Wireless Sensor Networks: Architecture, Applications, Advancements, by S. R. Vijayalakshmi and S. Muruganand, Mercury Learning and Information
7. A Complete Guide to Wireless Sensor Networks: from Inception to Current Trends, by Ankur Dumka, Arindam Biswas, Hardwari Lal Mandoria, and Sandip K. Chaurasiya, CRC Press

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Discrete Structure	IOT-5031(A)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Write an argument using logical notation and determine if the argument is or is not valid.

CO2 Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.

CO3 Understand the basic principles of sets and operations in sets.

CO4 Demonstrate an understanding of relations and functions and be able to determine their properties.

CO5 Model problems in Computer Science using graphs and trees.

Course Contents:

UNIT I

Set Theory- Introduction, Elements & Description, Types, Venn-Euler Diagrams, Operations, Inclusion and Exclusion Principle, Fuzzy sets, Functions- Introduction, Types, Range & Domain, Identity Function, Relations-Binary relation, Types, Partial Order, Equivalence relation, Hasse Diagram.

UNIT II

Principle of Mathematical Induction, Pigeonhole Principle, Mathematical Logic- Introduction, propositional calculus, Logical operation, Statement, Converse, Inverse & Contra-positive Statement, Tautologies, Contradiction, Quantifiers, Predicate calculus.

UNIT III

Algebric Structures- Introduction, Mathematical Operations, Binary operations, Groups- Permutation Groups, Cyclic Groups, Subgroup, Semigroup and Monoid, Homeomorphism and Isomorphism, Rings, Fields, Poset and Lattices – Introduction, Chain, Lattice, Duality, Types of Lattices.

UNIT IV

Graph Theory- Introduction, Types, Path, Cycles, Subgraph, Isomprphic Graph, Homeomorphic Graph, Eularian and Hamiltonian graphs, Shortest Path Problem, Planar Graph, Graph Colouring and

Chromatic Polynomials, Trees-Introduction, Properties, Binary tree, Computer representation of General Trees, Binary search Tree, Spanning Trees.

UNIT V

Recurrence Relations and Generating Functions- Introduction, Linear Recurrence Relations with Constant Coefficients, Methods of Solving Recurrence relations, Non-homogeneous Recurrence Relations, Methods of Generating Functions.

References:

1. Schaum's Outlines Discrete Mathematics 3e, by Seymour Lipschutz, Marc Laras Lipson, Varsha H. Patil, McGraw Hill Education
2. Discrete Mathematics and Its Applications 8e by Kenneth H. Rosen, Kamala Krithivasan, McGraw Hill Education
3. Discrete Mathematics with Ducks 2e, by Sarah-Marie Belcastro, CRC Press
4. Discrete Mathematics with Applications (Metric Version) 5e, by Susanna S. Epp, Cengage Learning India Pvt. Ltd.
5. Elements of Discrete Mathematics: A Computer Oriented Approach 4e, by C Liu, D. Mohapatra, McGraw Hill Education
6. Discrete Mathematics 4e, by JK Sharma, Trinity Press
7. Discrete Mathematics with Graph Theory 3e, by Edgar Goodaire and Michael Parmenter, Pearson Education

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Microprocessor and Interfacing	IOT-5031(B)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the architecture, instruction set, and addressing modes of 8085 and 8086 microprocessors.

CO2 Write and analyze assembly language programs for 8085/8086 for various computational and logical tasks.

CO3 Interface microprocessors with memory and I/O devices using suitable techniques.

CO4 Explain and implement interrupt handling mechanisms and DMA in microprocessor systems.

CO5 Demonstrate the ability to design microprocessor-based systems for real-world applications.

Course Contents:

UNIT I

Introduction to Microprocessors: Evolution of microprocessors, microprocessor vs. microcontroller, Overview of 8085 and 8086 architectures, Pin configuration and internal architecture, Instruction set classification and addressing modes

UNIT II

Assembly Language Programming: Instruction formats and types, Data transfer, arithmetic, logical, control flow instructions, Assembly language programming using 8085/8086, Stack and subroutines, Macros and procedures

UNIT III

Interfacing Concepts: Memory interfacing: RAM, ROM, EPROM, I/O interfacing: I/O mapped and memory-mapped I/O, Interfacing with keyboards, displays (LED, 7-segment, LCD), ADC and DAC interfacing

UNIT IV

Interrupts and DMA: Interrupt structure of 8085 and 8086, Hardware and software interrupts, Programmable interrupt controller (PIC) – 8259, Direct Memory Access (DMA), DMA controller – 8257

UNIT V

Peripheral Devices and System Design: Programmable Peripheral Interface (PPI) – 8255, USART – 8251, Programmable Timer/Counter – 8253/8254, Designing a microprocessor-based system

References:

1. Microprocessor Architecture, Programming and Applications with the 8085, 6e, by Ramesh Gaonkar, Penram International Publishing
2. Microprocessors And Interfacing, 3e, by Douglas V Hall, SSSP Rao, McGraw Hill Education
3. Advanced Microprocessor and Peripherals, 3e, by K Bhurchandi, A. K. Ray, McGraw Hill Education
4. The 8086 Microprocessor Programming & Interfacing The PC, by Kenneth J Ayala, Masood Books UP
5. Microprocessors and Microcontrollers Architecture, Programming and Interfacing Using 8085, 8086 and 8051, by Soumitra Mandal, McGraw Hill Education
6. The 8051 Microcontrollers & Embedded Systems, 2e, by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearson Education India

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Numerical Methods and Statistics	IOT-5031(C)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Apply numerical techniques to solve algebraic and transcendental equations.

CO2 Utilize numerical methods for interpolation, differentiation, and integration.

CO3 Solve systems of linear and non-linear equations using iterative techniques.

CO4 Implement numerical solutions for ordinary differential equations (ODEs).

CO5 Analyze and interpret data using statistical measures and probability distributions.

Course Contents:

UNIT I

Numerical Solution of Algebraic and Transcendental Equations: Bisection Method, Regula Falsi Method, Newton-Raphson Method, Secant Method, Convergence criteria and error analysis

UNIT II

Interpolation and Extrapolation: Finite Differences, Newton's Forward and Backward Interpolation, Lagrange Interpolation, Newton's Divided Difference

Numerical Differentiation and Integration: Numerical Differentiation using finite differences, Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Error estimation

UNIT III

Solution of Systems of Equations: Gauss Elimination and Gauss-Jordan Method, LU Decomposition, Gauss-Seidel and Jacobi Iterative Methods

UNIT IV

Numerical Solution of Ordinary Differential Equations: Euler's Method, Modified Euler's Method, Runge-Kutta Methods (2nd and 4th order), Predictor-Corrector Methods (Milne's Method)

UNIT V

Introduction to Statistics: Measures of Central Tendency: Mean, Median, Mode, Measures of Dispersion: Range, Variance, Standard Deviation, Probability Concepts and Distributions: Binomial,

Poisson, Normal, **Statistical Inference:** Sampling Distributions, Confidence Intervals, Hypothesis Testing (z-test, t-test, chi-square test), Correlation and Linear Regression Analysis

References:

1. Numerical Methods for Engineers, 8e, by Steven C. Chapra, Raymond P. Canale, McGraw-Hill Science Engineering
2. Numerical Methods: For Scientific and Engineering Computation, by Rk Jain Mk Jain,Srk Iyengar, New Age International Pvt. Ltd.
3. Introductory Methods of Numerical Analysis, 5e, by S.S. Sastry, PHI Learning Pvt. Ltd.
4. Numerical Methods in Engineering & Science with Programs in C, C++ and MATLAB, by Dr. B.S. Grewal, Khanna Publishers
5. Numerical Methods in Engineering with Python 3, by Jaan Kiusalaas, Cambridge University Press
6. Numerical Methods for Scientists and Engineers, by Richard W. Hamming, Dover Publications Inc.
7. Probability and Statistics for Engieers and Scientists 9e, by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson Education
8. The Elements of Statistical Learning: Data Mining Inference and Prediction 2e, by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer
9. Mining of Massive Datasets, 2e, by Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Dreamtech Press
10. An Introduction to Statistical Learning: with Applications in Python, by Gareth James, Daniela Witten, and Trevor Hastie, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Theory of Computation	IOT-5041(A)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages

CO2 Understand that there are limitations on what computers can do, and learn examples of unsolvable problems.

CO3 Learn that certain problems do not admit efficient algorithms, and identify such problems

CO4 Apply knowledge of computing and mathematics appropriate to the discipline

CO5 Function effectively as a member of a team in order to accomplish a common goal.

Course Contents:

UNIT I

AUTOMATA

Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions.

UNIT II

REGULAR EXPRESSIONS AND LANGUAGES

Regular Expression – FA and Regular Expressions – Proving languages not to be regular – Closure properties of regular languages – Equivalence and minimization of Automata.

UNIT III

CONTEXT-FREE GRAMMAR AND LANGUAGES

Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG, Deterministic Pushdown Automata.

UNIT IV

PROPERTIES OF CONTEXT-FREE LANGUAGES

Normal forms for CFG – Pumping Lemma for CFL - Closure Properties of CFL – Turing Machines– Programming Techniques for TM.

UNIT V

UNDECIDABILITY

A language that is not Recursively Enumerable (RE) – An undecidable problem that is RE – Undecidable problems about Turing Machine – Post's Correspondence Problem - The classes P and NP.

References:

1. Introduction to Languages and the Theory of Computation 4e, by John C. Martin, McGraw Hill Education
2. Introduction to Automata Theory, Languages, and Computation, 3e by John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, Pearson Education
3. Introduction to the Theory of Computation, 3e, by Michael Sipser, Cengage India Pvt. Ltd.
4. Theory of Computer Science: Automata, Languages and Computation 3e, by KLP Mishra and N. Chandrsekaran, PHI Learning Pvt. Ltd.
5. Theory of Computation Simplified, by Varsha H. Patil, Vaishali S. Pawar, Swati A. Bhvsar, Aboli H. Patil, BPB Publications
6. An Introduction to Formal Languages and Automata 7e, by Peter Linz, and Susan H. Rodge, Jones and Bartlett Publishers, Inc.
7. Elements of The theory of Computation 2e, HR Lewis and CH Papadimitriou, Pearson Education

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	E-Commerce and Governance	IOT-5041(B)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the basic concepts and technologies used in the field of e-commerce and e-governance.

CO2 Understand the processes of developing and implementing information Systems.

CO3 Be aware of the ethical, social, and security issues of e-payment and information systems.

CO4 Understand the impact of e-business on different fields and industries.

CO5 Understand the implications for the management of e-commerce and governance.

Course Contents:

UNIT I

Introduction to E-Business and E-Commerce: Definition the e-Commerce and e-Business, e-commerce Types of EC transactions, e-Business Models. Internet Marketing and e-Tailing, Elements of e-Business Models. benefits and limitations of e-Commerce.

UNIT II

E-Marketplaces: Structures, Mechanisms, Economics & impacts: Define e-Marketplace and their Functions. e-Marketplace types and their features. various types of auctions and list their characteristics. benefits, limitations and impacts of auctions. E-Commerce in the wireless environment. Competition in the DE and impact on industry.

UNIT III

E-Business Applications, E-Procurement and E-Payment Systems: Integration and e-Business suits, ERP, e-SCM, CRM, E-Payment. E-Procurement definition, processes, methods and benefits. Discuss the categories and users of smart cards. Describe payment methods in B2B EC.

UNIT IV

The Impact of E-Business on Different Fields and Industries: E-Tourism, Employment and Job Market Online Online Real Estate, Online Publishing and e-Books, Banking and Personal Finance Online, On-Demand Delivery Systems and E-Grocers, Online Delivery of Digital Products.

UNIT V

E-Learning and Online Education: Electronic learning, benefits and drawbacks of e-Learning. The e-Learning Industry. e-Content development and tools. Major technologies used in e-Learning. Different approaches for e-Learning delivery. Evaluation of e-Learning

Text Book:

1. Electronic Commerce: A Managerial Perspective, Turban, E. et al., Prentice Hall-2008.
2. Frontiers of e-commerce, Ravi Kalakota, Pearson.
3. Electronic Business and Electronic Commerce Management, 2nd edition, Dave Chaffey, Prentice Hall, 2006
4. e-Learning Tools and Technologies, Horton and Horton, Wiley Publishing.

References:

1. Electronic Commerce 2002: A Managerial Perspective, by Efraim Turban, David King, Jae K. Lee, Merrill Warkentin, and H. Michael Chung, Pearson Education
2. Frontiers of E-Commerce, Ravi Kalakota and Andrew B Whinston, Pearson Education
3. E-Business and E-Commerce, by Dave Chaffey, Prentice Hall
4. E-learning Tools and Technologies, by William Horton and Katherine Horton, John Wiley & Sons
5. Essentials of E-Commerce Technology, by V. Rajaraman, PHI Learning Pvt. Ltd.
6. E-Commerce: Fundamentals and Applications, by Henry Chan, Raymond Lee, Tharam Dillon, and Elizabeth Chang, Wiley
7. E-Governance: Concepts and Case Studies, by C.S.R. Prabhu, PHI Learning Pvt. Ltd.

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Java Programming	IOT-5041(C)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the knowledge of the structure and model of the Java programming language.

CO2 Use the Java programming language for various programming tasks.

CO3 Develop software in the Java programming language.

CO4 Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements.

CO5 Propose the use of certain technologies by implementing them in the Java programming language

Course Contents:

UNIT I

The Java Environment: Java Development Kit (JDK) , Java virtual machine, Java programming environment (compiler, interpreter, applet viewer, debugger), Java Applications Programming Interface(API), Basic idea of application and applet. Java as an object oriented language: objects, classes, encapsulation, inheritance and software reuse, polymorphism, abstract classes and abstract methods,: defining an interface, implementing & applying interfaces, variables in interfaces, extending interfaces, Packages, scope and life-time; Access specifies; Constructors; Copy constructor; this pointer; finalize() method; arrays; Memory allocation and garbage collection

UNIT II

AWT: Containers and components, AWT classes, window fundamentals: Component, Container, Panel, Window, Frame, Canvas, AWT Controls, Layout Managers and Menus: adding and removing control, Labels, Button, Check Box, Radio Button, Choice, menu, Text area, Scroll list, Scrollbar; Frame; Layout managers flow layout, Grid layout, Border layout, Card layout. Java Event Handling Model: Java's event delegation model - Ignoring the event, Self-contained events, Delegating events; The event class hierarchy; The relationship between interface, methods called, parameters and event source; Adapter classes; Event classes action Event, Adjustment Event, Container Event, Focus Event, Item Event, Eye Event, Mouse Event, Text Event, Window Event. Applets: Applet security restrictions; the class hierarchy for applets; Life cycle of applet; HTML Tags for applet Introduction to Swing: swing library, Building applications using Swings.

UNIT III

Multithreading and Exception Handling: Overview of simple threads, Basic idea of multi-threaded programming, Thread synchronization: Locks, synchronized methods, synchronized block, Thread scheduling, Producer-consumer relationship, Daemon thread, Basic idea of exception handling, stack based execution and exception propagation, Exception types: Exception Handling: Try, Catch, Finally, Throw statement, Assertions

UNIT IV

Input/Output: Exploring Java I/O, Directories, stream classes The Byte stream: Input stream, output stream, file input stream, file output stream, print stream, Random access file, the character streams, Buffered reader, buffered writer, print writer, serialization. JDBC: JDBC-ODBC bridge; The connectivity model; The driver manager; Navigating the result set object contents; java.sql Package; The JDBC exception classes; Connecting to Remote database.

UNIT V

Java Networking: exploring java. Net package Networking Basics: Socket, Client server, reserved sockets, servers, Internet addressing, TCP sockets, UDP sockets. RMI: Client/Server architecture, RMI registry services; Steps of creating RMI Application and an example.

References:

1. Java The Complete Reference, by Herbert Schildt, Tata McGraw Hill
2. Java How to Program, by Deitel & Deitel, Pearson Education
3. Programming with Java by E. Balaguruswamy, Tata McGraw Hill
4. Head First Java: A Brain-Friendly Guide, 3e, by Kathy Sierra, Bert Bates, and Trisha Gee, O'Reilly Media Inc.
5. Let Us Java, by Yashvant Kanetkar and Anuj Kanetkar, BPL Publications
6. Java RMI: Designing & Building Distributed Applications, by William Grosso, O’Reilly Media

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Lab (Linux)	IOT-5051	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Explain the fundamental concepts of open-source operating system Linux

CO2 Understand the basic set of commands and editors in Linux operating system.

CO3 Discuss shell programming in Linux operating system

Course Contents:

UNIT I

Linux Utilities:

File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities, Backup utilities Sed - Scripts, Operations, Addresses, Commands, awk - Execution, Fields and Records, Scripts, Operations, Actions, Assocoative Array, Strings and Mathematical functions, System commands in awk, Applications. Shell programming with Bourne Again Shell (bash): Introduction, Shell responsibilities, Pipes and redirection, here documents, running a shell script, Shell as a programming language, Shell meta characters, File-name substitution, Shell variables, Command substitution, Shell commands, the environment, Quoting, test command, Control structures, Arithmetic in shell, Shell script examples, Interrupt processing functions, Debugging shell Scripts

UNIT II

Files and Directories:

File concepts, File types File system structure, file metadata - Inodes, kernel support for files, System calls for the file I/O operations- open, create, read, wrirte, close, lseek, dup2, file status information-stat family, file and record locking-fcntl function, file permissions- chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links- symlink, link, unlink. Directories: Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory - getcwd, directory contents,scanning directories- opendir, readdir, rewin functions.

UNIT III

Process:

Process concept, Layout of a C program image in main memory, Process environment – environment list, environment variables, getenv, setenv, Kernel support for process, Process identification, Process control - Process creation, replacing a process image, waiting for process, Process termination, Zombie process, Orphan process, ,system call interface for process management – fork, vfork, exit, wait, waitpid, exec family, process groups, sessions and controlling Terminal, differences between threads and processes. Signals: Introduction to signals, Signal generation, Signal handling, Kernel support for signals, signal function, Unreliable signals, Reliable signals, Signal functions: kill, raise, alarm, pause, abort, sleep.

UNIT IV

Interprocess Communication:

Introduction to IPC,IPC between processes on a single computer system, IPC between processes on different systems, Pipes - creationIPC between related processes using FIFOs(Named pipes), differences between unnamed and named pips, popen and pclose library functions. Message Queues: Kernel support for messages, APIs for message queues, Client/Server example Semaphores: Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

UNIT V

Shared Memory:

Kernel support for Shared Memory, APIs for Shared Memory, Shared Memory example Sockets: Introduction to Berkley Sockets, IPC over a network, client – server model, Socket address structures (Unix domain and internet domain), Socket system calls for connection-oriented protocol and connectionless protocol, example- client/server programs- single server- client connection, multiple simultaneous clients, socket options - setsockopt and fcntl system calls, comparison of IPC mechanisms.

References:

1. Unix Shell Programming, by Yashavant Kanetkar, BPB Publications
2. Unix System Programming using C++, by T. Chan, PHI (Unit III to Unit VIII)
3. Unix Concepts and Applications, 4e, by Sumitabha Das, Tata McGraw Hill
4. Unix Network Programming, by W.R. Stevens, PHI
5. Beginning Linux Programming, 4e, by N. Matthew, R.Stones, Wrox, Wiley India Edition
6. Unix for Programmers 3e, by Graham Glass & King Ables, Pearson Education
7. System Programming with C and Unix, by A. Hoover, Pearson Education
8. Unix System Programming, Communication, Concurrency and Threads, by K.A. Robbins and S. Robbins, Pearson Education
9. Unix Shell Programming, by S.G. Kochan and P.Wood, 3rd edition, Pearson Education
10. Shell Scripting, by S. Parker, Wiley India Pvt. Ltd.
11. Advanced Programming in the Unix Environment, 2e, by W.R. Stevens, Pearson Education
12. Unix and Shell Programming, B.A. Forouzan & R.F. Gilberg, Cengage Learning
13. Linux System Programming, Robert Love, O'Reilly, SPD.

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – V
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Lab (Python)	IOT-5061	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Write, Test and Debug Python Programs

CO2 Implement Conditionals and Loops for Python programs

CO3 Use functions and represent Compound data using Lists, Tuples and Dictionaries

Course Contents:

UNIT I

Introduction to Python Programming Language:
Introduction to Python Language, Strengths and Weaknesses, IDLE, Dynamic Types, Naming Conventions, String Values, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Built In Functions

UNIT II

Data Collections and Language Component:
Introduction, Control Flow and Syntax, Indenting, the if Statement, Relational Operators, Logical, Operators, True or False, Bit Wise Operators, The while Loop, break and continue, The for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections.

UNIT III

Object and Classes:
Classes in Python, Principles of Object Orientation, Creating Classes, Instance Methods, File Organization Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes

UNIT IV

Functions and Modules:
Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, Functions - "First Class Citizens", Passing Functions to a Function, Mapping Functions in a Dictionary,

Lambda, Modules, Standard Modules – sys, Standard Modules – math, Standard Modules – time, The dir Function

UNIT V

I/O and Error Handling In Python:

Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Using Pipes as Data Streams, Handling IO Exceptions, Working with Directories, Metadata, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions.

LIST OF EXPRIMENTS:

1. Running instructions in Interactive interpreter and a Python Script.
2. Write a program to purposefully raise Indentation Error and correct it.
3. Scientific problem-solving using decision making and looping.
4. Simple programming for one dimensional and two-dimensional arrays.
5. Python Programing to explore string functions.
6. Utilizing 'Functions' in Python
    a. Find mean, median, mode for the given set of numbers in a list.
    b. Write a function dups to find all duplicates in the list.
    c. Write a function unique to find all the unique elements of a list.
    d. Write function to compute gcd, lcm of two numbers
7. Demonstrate the use of Lists, Dictionaries.
8. Write a program to implement Turtle.
9. Building a Classical Data Structure using Python Programming.
10. Implement Searching Operations: Linear and Binary Search.
11. To sort the 'n' numbers using: Selection and Insertion Sort.
12. Find the most frequent words in a text read from a file.
13. Demonstrate Exceptions in Python.
14. Simulate elliptical orbits and bouncing ball using Pygame

References:

1. Python Programming Fundamentals 2e, Kent D. Lee, Springer
2. Automate the Boring Stuff with Python Paperback by Al Sweigart, No Starch Press
3. Intro to Python for Computer Science and Data Science: Learning to Program with AI, Big Data and The Cloud Paperback by Paul J. Deitel, Harvey M. Deitel, Pearson Education
4. Think Python 3rd Edition, 3e, by Allen Downey, O'Reilly Media
5. Let Us Python, by Yashavant Kanetkar, BPL Publications
6. Python Adventures for Young Coders - Explore the World of Programming, by Alaa Tharwat, Apress
7. Learning Python: Powerful Object-Oriented Programming 6e, by Mark Lutz, O'Reilly Media
8. Python Cookbook, by David M. Baezly, O'Reilly Media

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Machine Learning	IOT-6011	4L-0T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Provide an understanding of the theoretical concepts of machine learning.

CO2 Learn the most cost-effective approaches to automated knowledge acquisition in emerging data-rich disciplines.

CO3 Focus on the theoretical understanding of machine learning methods, as well as their computational implications.

CO4 Prepare the research and industry application of machine learning techniques.

Course Contents:

UNIT I

Introduction: Machine Learning (ML), Types of ML, (Supervised, Unsupervised, Semi-supervised, Reinforcement Learning), Applications of ML, Differences from AI, Deep Learning, and Statistics, hypothesis space and inductive bias, evaluation, cross-validation, Dimensionality Reduction: Subset Selection, Shrinkage Methods, Partial Least Squares.

UNIT II

Clustering in Machine Learning: Types of Clustering Method: Partitioning Clustering, Distribution Model-Based Clustering, Hierarchical Clustering, Fuzzy Clustering. Birch Algorithm, CURE Algorithm. Gaussian Mixture Models and Expectation Maximization. Parameters estimations – MLE, MAP. Applications of Clustering.

UNIT III

Classification algorithm: - Logistic Regression, Decision Tree Classification, Neural Network, K-Nearest Neighbors (K-NN), Support Vector Machine, Naive Bayes (Gaussian, Multinomial, Bernoulli). Performance Measures: Confusion Matrix, Classification Accuracy, Classification Report: Precisions, Recall, F1 score and Support.

UNIT IV

Ensemble Learning and Random Forest: Introduction to Ensemble Learning, Basic Ensemble Techniques (Max Voting, Averaging, Weighted Average), Voting Classifiers, Bagging and Pasting,

Out-of-Bag Evaluation, Random Patches and Random Subspaces, Random Forests (Extra-Trees, Feature Importance), Boosting (AdaBoost, Gradient Boosting), Stacking.

UNIT V

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction (Projection, Manifold Learning) PCA: Preserving the Variance, Principal Components, Projecting Down to d Dimensions, Explained Variance Ratio, Choosing the Right Number of Dimensions, PCA for Compression, Randomized PCA, Incremental PCA. Kernel PCA: Selecting a Kernel and Tuning Hyper parameters. Learning Theory: PAC and VC model.

References:

1. Machine Learning, by Tom M. Mitchell, McGraw Hill Education
2. Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems, by Aurelien Geon, O'Reilly Media
3. Machine Learning in Action, by Peter Harrington, Manning
4. Real-World Machine Learning Paperback by Henrik Brink, Joseph W. Richards, Mark-Fetherolf, and Beau Cronin, Manning
5. Simplified Machine Learning by Pooja Sharma, BPB Publications
6. Advanced Machine Learning: Fundamentals and Algorithms by Amit Tyagi, Avinash Sharma, and Khushboo Tripathi, BPB Publications
7. Introduction to Machine Learning with Python: A Guide for Data Scientists, by Andreas Muller, O'Reilly Media

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Compiler Design	IOT-6021	3L-1T-2P	6

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the different phases of compiler.

CO2 Design lexical analyzer for a sample language.

CO3 Apply different parsing algorithms to develop the parsers for a given grammar.

CO4 Understand syntax-directed translation and run-time environment.

CO5 Learn to implement code optimization techniques and a simple code generator.

Course Contents:

UNIT I

INTRODUCTION TO COMPILERS: Structure of a compiler–Lexical Analysis–Role of Lexical Analyzer–Input Buffering–Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata–Minimizing DFA.

UNIT II

SYNTAX ANALYSIS: Role ofParser– Grammars– Error Handling– Context-free grammars – Writing a grammar–TopDown Parsing- General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LRParser- LR(0) Item Construction of SLR Parsing Table-Introduction to LALR Parser-Error Handling and Recovery in Syntax Analyzer-YACC.

UNIT III

INTERMEDIATE CODE GENERATION: Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT IV

RUN-TIME ENVIRONMENT AND CODE GENERATION: Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management- Issues in Code Generation-Design of a simple Code Generator.

UNIT V

CODE OPTIMIZATION: Principal Sources of Optimization–Peep-hole optimization-DAG- Optimization of Basic Blocks- Global Data Flow Analysis- Efficient Data Flow Algorithm.

References:

1. Compilers: Principles, Techniques and Tools, 2e, by Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman. Pearson Education
2. Principles of Compiler Design, by Alfred V Aho and Jeffrey D. Ullman, Narosa Publishing house
3. Compiler Design in C by Allen I. Holub, PHI Learning Pvt. Ltd.
4. Compiler Design by K. Muneeswaran, Oxford University Press
5. Compiler Design: Analysis and Transformation by Helmut Seidl, Reinhard Wilhelm, and Sebastian Hack, Springer
6. Compiler Design by Santanu Chattopadhyay, PHI Learning Pvt. Ltd.
7. Principles of Compiler Design‖, by V. Raghavan, Tata McGraw Hill Education
8. Optimizing Compilers for Modern Architectures: A Dependence based Approach, by Randy Allen and Ken Kennedy, Morgan Kaufmann Publishers
9. Advanced Compiler Design and Implementation, by Steven S. Muchnick, Morgan Kaufmann (Elsevier)
10. Engineering a Compiler, by Keith D Cooper and Linda Torczon, Morgan Kaufmann (Elsevier)

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cyber Security	IOT-6031(A)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Be able to analyze and evaluate the cyber security needs of an organization.

CO2 Be able to Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

CO3 Be able to Measure the performance and troubleshoot cyber security systems.

CO4 Be able to Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.

CO5 Be able to Design and develop security architecture for an organization.

Course Contents:

UNIT I

Introduction of Cyber Crime, Challenges of cyber-crime, Classifications of Cybercrimes: E- Mail Spoofing, Spamming, Internet Time Theft, Salami attack/Salami Technique, Data Diddling, Web jacking, Online Frauds, Software Piracy, Computer Network Intrusions, Password Sniffing, Identity Theft, cyber terrorism, Virtual Crime , Perception of cyber criminals: hackers, insurgents and extremist group etc. Web servers hacking, session hijacking.

UNIT II

Cybercrime on Mobile and Wireless Device: Proliferation of Mobile and Wireless Devices, trends in Mobility Credit Card Frauds in Wireless Computing, Types and techniques of Credit Card Frauds, Attacks on Mobiles: Mobile Viruses, Mishing, Vishing, Smishing & Hacking Bluetooth. Web servers hacking, session hijacking.

UNIT III

Tools and Methods in Cybercrime: Proxy Servers and Anonymizers, Password Cracking, Keyloggers and Spyware, virus and worms, Trojan Horses, Backdoors, DoS and DDoS Attacks , Buffer and Overflow, Attack on Wireless Networks, Phishing : Method of Phishing, Phishing Techniques.

UNIT IV

Cyber Crime and Criminal justice: Concept of Cyber Crime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cheating, Defamation, Harassment and E-mail Abuse, Other IT Act Offences, Monetary Penalties, jurisdiction and Cyber Crimes, Nature of Criminality, Strategies to tackle Cyber Crime and Trends. The Indian Evidence Act of 1872 v. Information Technology Act, 2000: Status of Electronic Records as Evidence, Proof and Management of Electronic Records; Relevancy, Admissibility and Probative Value of E-Evidence, Proving Digital Signatures, Proof of Electronic Agreements, Proving Electronic Messages.

UNIT V

Introduction to Cyber Forensics: Information Security Investigations, Corporate Cyber Forensics, Scientific Method in Forensic analysis, investigating large scale Data breach cases. Analyzing Malicious software. Types of Computer Forensics Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques.

References:

1. Principles of Cyber Crime, by Jonathan Clough, Cambridge University Press
2. Computer Forensics: Computer Crime Scene Investigation, 2e, by John R. Vacc, Charles River Media
3. Cyber Law Simplified, by Vivek Sood, Tata McGraw Hill
4. Cyber Security, by Nina Godbole and Sunit Belapure, Willey-India
5. Information Warfare: Corporate attack and defense in digital world, by William Hutchinson and Mathew Warren, Elsevier
6. Cyber Laws and IT Protection, by Harish Chander, PHI.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Deep Learning	IOT-6031(B)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

- CO1 Explain the fundamentals of neural networks and deep learning architectures
- CO2 Implement and train neural network models using backpropagation and optimization techniques
- CO3 Analyze and evaluate the performance of various deep learning models on real-world datasets.
- CO4 Apply convolutional and recurrent neural networks to solve tasks such as image classification and sequence modeling
- CO5 Explore and critique recent advancements in deep learning, such as generative models and attention mechanisms

Course Contents:

UNIT I

Introduction to Neural Networks: Biological vs Artificial Neurons, Perceptron Model, Activation Functions (Sigmoid, Tanh, ReLU, etc.), Loss Functions, Training Neural Networks

UNIT II

Deep Neural Networks: Gradient Descent and Backpropagation, Vanishing/Exploding Gradients, Optimization Techniques: SGD, Momentum, Adam, RMSprop, Regularization: L1/L2, Dropout, Batch Normalization, Hyperparameter Tuning

UNIT III

Convolutional Neural Networks (CNNs): Convolution and Pooling Layers, CNN Architectures: LeNet, AlexNet, VGG, ResNet, Applications in Image Classification, Object Detection

UNIT IV

Recurrent Neural Networks (RNNs): Basic RNNs and their limitations, LSTM and GRU Networks, Sequence-to-Sequence Models, Applications in NLP and Time Series

UNIT V

Generative Models: Autoencoders, Variational Autoencoders (VAE), GANs, Transfer Learning and Fine-Tuning, Attention Mechanisms and Transformers (BERT, GPT), Explainability and Interpretability in Deep Learning

References:

1. Deep Learning, by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, The MIT Press
2. Neural Networks and Learning Machines, 3e, by Haykin, Pearson Education India
3. Deep Learning, by S. Sridhar, D. Narashiman, Pearson Education India
4. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, by Jon Krohn, Grant Beyleveld, Aglae Bassens, Pearson Education India
5. Neural Networks and Deep Learning: A Textbook, 2e, by Charu C. Aggarwal, Springer Nature
6. Fundamentals of Artificial Neural Networks, by Hassoun, PHI Learning Pvt. Ltd.
7. Deep Learning: Foundations and Concepts, by Christopher M. Bishop and Hugh Bishop, Springer Nature
8. Deep Learning, by John D. Kelleher, The MIT Press
9. Learning Deep Learning, by Magnus Ekman, Pearson Education
10. Dive into Deep Learning, by Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Cambridge University Press

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Embedded System	IOT-6031(C)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Explain the embedded system concepts and architecture of embedded systems.

CO2 Describe the architecture of 8051 microcontroller and write embedded program for it.

CO3 Select elements for an embedded systems tool

CO4 Understand the memory types used in embedded systems

CO5 Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Course Contents:

UNIT I

Introduction to Embedded Systems: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.

UNIT II

Embedded System Architecture: Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.

UNIT III

Input Output and Peripheral Devices Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock. Introduction to communication protocols: basic terminologies, concepts, serial protocol: I2C, CAN, firewire, USB. Parallel protocols: PCI bus, IrDA, bluetooth, IEEE 802.11, wireless protocols.

UNIT IV

Memory System Architecture Caches, virtual memory, MMU, address translation, memory and interfacing, memory write ability and storage performance. Memory types, composing memory – advance RAM interfacing, microprocessor interfacing I/O addressing, interrupts, direct memory access, arbitration multilevel bus architecture.

UNIT V

Embedded System Supporting Technologies, Difference between normal OS and RTOS, scheduling algorithms. Case study: Tiny OS, VxWorks, QNX. Overview of VLSI technology, introduction to device drivers, Case studies: washing machine, air-conditioning, auto focus camera

References:

1. Embedded Systems Introduction, 4e, by Raj Kamal, McGraw Hill Education
2. Making Embedded Systems: Design Patterns for Great Software, 2e, by Elecia White, O'Reilly Media
3. Embedded Systems: A Contemporary Design Tool, 2e, by James K. Peckol, Wiley
4. Introduction to Embedded Systems, 2e, by K.V. Shibu, McGraw Hill Education
5. Introduction to Embedded Systems, 2e, by Ashford Lee Edward, PHI Learning Pvt. Ltd.
6. An Embedded Software Primer, by David E Simons, Pearson Education
7. Embedded System Design: A Unified Hardware/Software Introduction, by Frank Vahid and Tony Givargis, Wiley

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Security in Edge Computing	IOT-6041(A)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

- CO1 Understand the architecture and key components of edge computing systems and how they differ from cloud computing
- CO2 Analyze the threat landscape specific to edge computing environments, including device-level, network-level, and application-level vulnerabilities
- CO3 Evaluate and apply security principles and techniques to protect data, communication, and computation at the edge
- CO4 Design and implement lightweight security mechanisms suitable for resource-constrained edge devices
- CO5 Assess and compare various existing security frameworks, protocols, and tools used in edge and fog computing

Course Contents:

UNIT I

Introduction to Edge Computing: Definition and evolution of edge computing, Edge vs. Fog vs. Cloud computing, Use cases: IoT, smart cities, autonomous vehicles, healthcare, Edge computing architecture and deployment models

UNIT II

Security Challenges in Edge Computing: Threat modeling for edge environments, Attack surfaces: device, network, data, APIs, Trust and adversarial models

Device and Network Security: Secure boot and firmware integrity, Hardware-based security (TPM, Secure Enclaves), Network security protocols (TLS, VPNs, SDN for edge), Intrusion detection/prevention systems (IDS/IPS) at the edge

UNIT III

Data Security and Privacy: Data encryption and key management in edge networks, Homomorphic encryption, data masking, differential privacy, Secure data aggregation, GDPR and other privacy regulations impacting edge computing

UNIT IV

Lightweight and Adaptive Security: Lightweight cryptography for constrained devices, Adaptive authentication and access control, Blockchain and distributed ledger technologies in edge networks, Resource-aware threat detection systems

Secure Communication Protocols and Frameworks: MQTT, CoAP, and other IoT protocols, Secure firmware and software updates, Remote attestation and device identity management, Middleware and API security

UNIT V

Modern Trends: AI for anomaly detection at the edge, Federated learning and its security/privacy implications, Cyber-physical system (CPS) security, Zero Trust architecture for edge environments, Security in Industrial IoT (IIoT), Autonomous vehicle edge security, Edge in healthcare and privacy-preserving analytics

References:

1. Secure Edge Computing for IoT, by Oluyemi James Odeyinka, Orange Education Pvt. Ltd.
2. Edge Computing: A Primer, by Jie Cao, Quan Zhang and Weisong Shi, Springer
3. Security and Privacy in Internet of Things IoTs: Models, Algorithms, and Implementations, by Fei Hu, CRC Press
4. Cloud Security in the Edge and Fog Computing Era, by Yogesh Ramaswamy, LAP Lambert Academic Publishing
5. Fog/Edge Computing for Security, Privacy, and Applications, by Wei Chang and Jie Wu, Springer
6. Real-World Edge Computing: Scale, secure, and succeed in the realm of edge computing with Open Horizon, by Robert High and Sanjeev Gupta, Packt Publishing
7. Privacy-Preserving in Edge Computing, by Longxiang Gao, Tom H. Luan, Bruce Gu, Youyang Qu, and Yong Xiang, Springer
8. Edge Computing in Action, by Tom Taulli, Apress

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Internet of Things	IOT-6041(B)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the vision of IoT from a global context.

CO2 Understand the application of IoT.

CO3 Determine the Market perspective of IoT.

CO4 Use of Devices, Gateways and Data Management in IoT.

CO5 Building state of the art architecture in IoT.

Course Contents:

UNIT I

IoT & Web Technology - The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT II

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

M2M to IoT - An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT III

IoT Architecture: State of the Art – Introduction, State of the art, Architecture Reference Model - Introduction, Reference Model and architecture, IoT reference Model,

IoT Reference Architecture - Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT IV

IoT Applications for Value Creations - Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to

Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT V

Internet of Things Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in DS-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

References:

1. Internet of Things (IoT): Architecture and Design Principles 2e, by Raj Kamal, McGraw Hill Education
2. Internet of Things, by Jeeva Jose, Khanna Book Publishing
3. Internet of Things (IoT) & Its Applications, by Satish Jain and Shashi Singh, BPB Publications
4. Internet of Things: Architecture, Implementation and Security, by Mayur Ramgir, Pearson Education
5. Internet of Things by Srinivasa K. G., Siddesh G. M., Hanumantha Raju R., Cengage Learning Pvt. Ltd.
6. Internet of Things by Surya Durbha, Jyoti Joglekar, Oxford University Press
7. Internet of Things A Hands-on-Approach, by Vijay Madisetti and Arshdeep Bahga, University Press
8. Getting Started with the Internet of Things, by Cuno Pfister, O'Reilly Media

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cloud Computing	IOT-6041(C)	4L-0T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the concepts, characteristics, delivery models and benefits of cloud computing.

CO2 Understand the key security and compliance challenges of cloud computing.

CO3 Understand the key technical and organisational challenges.

CO4 Understand the different characteristics of public, private and hybrid cloud deployment models.

Course Contents:

UNIT I

Introduction:
Historical development, Vision of Cloud Computing, Characteristics of cloud computing as per NIST, Cloud computing reference model, Cloud computing environments, Cloud services requirements, Cloud and dynamic infrastructure, Cloud Adoption and rudiments. Overview of cloud applications: ECG Analysis in the cloud, Protein structure prediction, Gene Expression Data Analysis, Satellite Image Processing, CRM and ERP, Social networking.

UNIT II

Cloud Computing Architecture:
Cloud Reference Model, Types of Clouds, Cloud Interoperability & Standards, Scalability and Fault Tolerance, Cloud Solutions: Cloud Ecosystem, Cloud Business Process Management, Cloud Service Management. Cloud Offerings: Cloud Analytics, Testing Under Control, Virtual Desktop Infrastructure

UNIT III

Cloud Management & Virtualization Technology:
Resiliency, Provisioning, Asset management, Concepts of Map reduce, Cloud Governance, High Availability and Disaster Recovery. Virtualization: Fundamental concepts of compute, storage, networking, desktop and application virtualization. Virtualization benefits, server virtualization, Block and file level storage virtualization Hypervisor management software, Infrastructure Requirements, Virtual LAN (VLAN) and Virtual SAN (VSAN) and their benefits.

UNIT IV

Cloud Security:

Cloud Information security fundamentals, Cloud security services, Design principles, Secure Cloud Software Requirements, Policy Implementation, Cloud Computing Security Challenges, Virtualization security Management, Cloud Computing Security Architecture.

UNIT V

Market Based Management of Clouds, Federated Clouds/Inter Cloud: Characterization and Definition, Cloud Federation Stack, Third Party Cloud Services. Case study: Google App Engine, Microsoft Azure, Hadoop, Amazon, Aneka

References:

1. Mastering Cloud Computing 2e, by Rajkumar Buyya, Christian Vecciola, Thamarai Selvi, Shivananda Poojara and Satish N. Srirama, McGraw Hill Education
2. Cloud Computing, by Shailendra Singh, Oxford University Press
3. Cloud Computing for Everyone: Understanding Principles, Architecture, Security, Data, and Green Practices, by Rohit Agarwal, and Dilip K Prasad, BPB Publications
4. Cloud Computing: Concepts, Technology, Security & Architecture, 2e, by Thomas Erl and Eric Barceló Monroy, Pearson Education
5. Cloud Computing: A Practical Approach, by Toby Velte, Anthony Velte and Robert Elsenpeter, McGraw Hill Education
6. Cloud Computing: A Hands-On Approach, by Arshdeep Bahga and Vijay Madisetti, The Orient Blackswan
7. Cloud Computing Bible, by Barrie Sosinsky, Wiley
8. Cloud Computing: Architecting Next-Gen Transformation Paradigms, 4e, by Kumar Saurabh, Wiley

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Data Analytics Lab	IOT-6051	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the basics of software as a product.

CO2 List the components of Hadoop and Hadoop Eco-System.

CO3 Access and Process Data on Distributed File System.

CO4 Manage Job Execution in Hadoop Environment.

CO5 Develop Big Data Solutions using Hadoop Eco System.

Course Contents:

UNIT I

Basics of data analytic framework, data per-processing, Statistics, probability, Probability Distribution, Bayes' Theorem, Central Limit theorem, Data Exploration & preparation, Concepts of Correlation, Regression, Covariance, Outliers, Data visualization.

UNIT II

Introduction to R as a data analytics tool.

UNIT III

Introduction to MATLAB as a data analytics tool.

UNIT IV

Introduction to Python as a data analytics tool.

UNIT V

Case studies.

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
THIRD YEAR, Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	R Programming Lab	IOT-6061	0L-0T-2P	2

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the fundamentals of R programming, including data types, control structures, and functions.

CO2 Import, clean, manipulate, and manage data using R and its packages.

CO3 Perform basic and advanced statistical analysis using R.

CO4 Create effective visualizations using base R and packages like ggplot2.

CO5 Develop and debug R scripts for solving real-world data problems.

Course Contents:

UNIT I

Introduction to R: Installation and setup (R, RStudio), R as a statistical programming language, RStudio interface and workflow, Basic syntax: variables, operators, expressions, Data Structures in R: Vectors, Lists, Matrices, Arrays, Data Frames and Tibbles, Factors and Dates, Indexing and Subsetting

UNIT II

Control Structures and Functions: Conditional statements: if, else, switch, Loops: for, while, repeat, user-defined functions, scope and environments, apply family of functions (apply, lapply, sapply, etc.)

UNIT III

Data Handling and Manipulation: Reading/writing data: CSV, Excel, JSON, etc., dplyr, tidyr, and data.table for data wrangling, Data cleaning: missing values, outliers, reshaping

UNIT IV

Data Visualization: Base R plotting, Grammar of Graphics and ggplot2, Plot types: histograms, boxplots, bar charts, line graphs, scatterplots, Customization and themes

UNIT V

Statistical Analysis in R: Descriptive statistics, Hypothesis testing: t-tests, chi-square, ANOVA, Correlation and regression, Basic time series analysis, Machine Learning with caret or mlr3, Text

processing using tm or tidytext, R Markdown for dynamic reports, Shiny for interactive web applications

References:

1. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, 2e, by Hadley Wickham, Shroff/O'Reilly
2. The Art of R Programming, by Norman Matloff, No Starch Press
3. Statistical Programming in R, by K.G. Srinivasa, G.M. Siddesh, Chetan Shetty, and B.J. Sowmya, Oxford University Press
4. R for Everyone: Advanced Analytics and Graphics, 2e, by Jared P. Lander, Pearson Education
5. Hands on Programming With R: Write Your Own Functions and Simulations, by Garrett Grolemund, Shroff/O'Reilly
6. R Programming for Beginners, by Sandip Rakshit, McGraw Hill Education
7. Advanced R, by Hadley Wickham, CRC Press
8. Hands on Data Science with R: From basics to advanced, by Dr. Meenakshi, Mrs. Nandini S. R, Dr. C. Mahiba, and Dr. Nanditha B. R., Clever Fox Publishing

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Industrial IoT and Industry 4.0	IOT-7011	2L-1T-1P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

- CO1 Understand the architecture, components, and communication technologies used in Industrial IoT
- CO2 Analyze the core concepts and technologies that enable Industry 4.0, such as cyber-physical systems, cloud computing, and AI
- CO3 Evaluate protocols, standards, and frameworks specific to IIoT applications
- CO4 Design and implement IIoT solutions using sensors, actuators, microcontrollers, and communication protocols
- CO5 Assess challenges in IIoT systems including scalability, interoperability, security, and real-time constraints

Course Contents:

UNIT I

Introduction to Industrial Internet of Things and Industry 4.0: Evolution from traditional automation to Industry 4.0, Concepts: Smart factory, digital twin, CPS (Cyber-Physical Systems), IIoT vs. consumer IoT, Key enabling technologies: IoT, AI, cloud, edge computing, robotics

UNIT II

IIoT Architecture and Components: Sensing and actuation layers, Embedded systems and microcontrollers in IIoT, Communication protocols: MQTT, CoAP, OPC-UA, Modbus, etc. IIoT platforms: AWS IoT, Azure IoT Hub, Siemens MindSphere

UNIT III

Communication and Networking in IIoT: Wired and wireless technologies: Ethernet, LoRaWAN, Zigbee, 5G, Wi-Fi 6, Time-sensitive networking (TSN), Edge and fog computing in industrial environments, Network architecture: SCADA, ICS, PLC integration, Industrial data collection, preprocessing, storage, Real-time data analytics and visualization tools, Role of AI in predictive maintenance and anomaly detection, Cloud vs. edge analytics

UNIT IV

Industry 4.0 Standards and Interoperability: RAMI 4.0 (Reference Architecture Model for Industry 4.0), IIRA (Industrial Internet Reference Architecture), Digital twin and interoperability challenges, Semantic modeling and OPC-UA information modeling

UNIT V

Realtime Applications: Smart manufacturing and predictive maintenance, Smart grid and energy management, Logistics and supply chain automation, Healthcare and industrial robotics use cases, IIoT implemetation using Raspberry Pi, Arduino, ESP32, Integration with cloud platforms, Real-time monitoring dashboards, Sensor used in Industrial applications

References:

1. Introduction to Industrial Internet of Things and Industry 4.0, by Sudip Misra, Chandana Roy, and Anandarup Mukherjee, CRC Press
2. Industry 4.0: The Industrial Internet of Things, by Alasdair Gilchrist, Apress
3. Industry 4.0, by Saikat Dutt, Arindam Ray, and Sobhan Sen Sarma, Pearson Education
4. Hands-On Industrial Internet of Things, by Giacomo Veneri Antonio Capasso, Packt Publishing
5. Industrial Internet of Things: Technologies and Research Directions, by Anand Sharma, Sunil Kumar Jangir, Manish Kumar, Dilip Kumar Choubey, Tarun Shrivastava, and S. Balamurugan, CRC Press
6. The Internet of Things in the Industrial Sector: Security and Device Connectivity, Smart Environments, and Industry 4.0, by Zaigham Mahmood. Springer
7. Industrial Internet of Things: Cybermanufacturing Systems, by Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat, Springer
8. Sensors and Protocols for Industry 4.0: Industrial Applications of Maker Tech, by G. R. Kanagachidambaresan and Bharathi N, Apress
9. Internet of Things for Industry 4.0: Design, Challenges and Solutions, by G. R. Kanagachidambaresan, R. Anand, E. Balasubramanian, and V. Mahima, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cyber Physical System	IOT-7021(A)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Explain the architecture and fundamental principles of cyber-physical systems

CO2 Model and analyze CPS using mathematical and computational tools

CO3 Design embedded control systems that integrate computing with physical processes

CO4 Evaluate communication protocols and middleware used in CPS

CO5 Identify and mitigate security, safety, and reliability challenges in CPS environments

Course Contents:

UNIT I

Introduction to Cyber-Physical Systems: Definition and evolution of CPS, Examples: Smart grids, autonomous vehicles, medical devices, industrial automation, CPS vs Embedded Systems vs IoT, Key design challenges: real-time, safety, security, scalability

UNIT II

CPS Architecture and Components: Cyber and physical system integration, Sensors, actuators, embedded controllers, Feedback control systems, Software-hardware co-design principles, Modeling physical systems: differential equations, finite state machines, Hybrid system modelling

UNIT III

Embedded Systems and Real-Time Computing: Real-time operating systems (RTOS), Scheduling algorithms: RMS, EDF, Timing analysis and worst-case execution time (WCET), Resource-constrained computing, **Networking and Communication in CPS:** Wired and wireless communication: CAN, Zigbee, 6LoWPAN, MQTT, Networked control systems, Middleware: DDS, ROS, Time synchronization and latency constraints

UNIT IV

Safety, Security, and Reliability in CPS: Threat modeling and attack surfaces, Safety-critical system design, Fault detection, isolation, and recovery, Formal verification and model checking

UNIT V

Applications: Autonomous vehicles (sensor fusion, control loops), Smart grids (distributed control, demand-response), Industrial automation (PLCs, SCADA integration), Healthcare CPS (smart prosthetics, remote surgery)

References:

1. Cyber-Physical Systems, by Raj Rajkumar, Dionisio De Niz, and Mark Klein, Pearson Education
2. Cyber-Physical Systems: A Model-Based Approach, by Walid M. Taha, Abd-Elhamid M. Taha, and Johan Thunberg, Springer
3. Principles of Cyber-Physical Systems, by Rajeev Alur, The MIT Press
4. Cyber-Physical Systems: Foundations, Principles and Applications, by Houbing Herbert Song PhD, Danda B. Rawat, Sabina Jeschke, and Christian Brecher, Academic Press
5. Introduction to Embedded Systems: A Cyber-Physical Systems Approach, 2e, by Ashford Lee Edward, PHI Learning Pvt. Ltd.
6. Cyber Physical Systems: Architectures, Protocols and Applications, by Chi Liu and Yan Zhang, CRC Press
7. Cyber-Physical Systems: Digital Technologies and Applications, by Alexander A. Bolshakov, Alla G. Kravets, and Maxim V. Shcherbakov, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Ethical Hacking and Penetration Testing	IOT-7021(B)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the principles, phases, and legal/ethical aspects of ethical hacking

CO2 Identify and analyze system vulnerabilities through reconnaissance and scanning techniques

CO3 Evaluate and exploit security weaknesses using penetration testing methodologies

CO4 Apply tools and techniques for network, web, wireless, and system penetration testing

CO5 Demonstrate practical skills in identifying, exploiting, and mitigating real-world security threats in controlled environments

Course Contents:

UNIT I

Introduction to Ethical Hacking: Fundamentals of hacking and hacker types, Ethical hacking vs. malicious hacking, Phases of ethical hacking, Laws, policies, and legal implications (India's IT Act, GDPR, etc.), Professional ethics and responsible disclosure

UNIT II

Reconnaissance and Information Gathering: Passive vs. active reconnaissance, DNS and WHOIS enumeration, Social engineering basics, OSINT tools: Maltego, theHarvester, Shodan
Scanning and Enumeration: Network scanning (Nmap, Zenmap), Port scanning and service enumeration, Banner grabbing and fingerprinting, Vulnerability scanning (Nessus, OpenVAS)

UNIT III

Exploitation Techniques: System hacking: password attacks, privilege escalation, Exploiting network vulnerabilities, Common exploits: buffer overflow, SQL injection, XSS, Metasploit Framework basics
Web Application Penetration Testing: OWASP Top 10 vulnerabilities, Web app attack techniques (SQLi, XSS, CSRF, SSRF), Tools: Burp Suite, OWASP ZAP, Web shell and backdoor access

UNIT IV

Wireless and Mobile Hacking: Wireless security protocols (WEP, WPA/WPA2), Wi-Fi attacks: sniffing, spoofing, MITM, Tools: Aircrack-ng, Wireshark, Kismet, Introduction to mobile app security testing

UNIT V

Post-Exploitation and Maintaining Access: Covering tracks and clearing logs, Creating and using backdoors, Data exfiltration techniques, Lateral movement in networks

Penetration Testing: Penetration testing lifecycle, Risk rating (CVSS, CVE), Reporting format and remediation strategies, Industry certifications overview (CEH, OSCP)

References:

1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, by Patrick Engebretson, Syngress
2. Penetration Testing: A Hands-On Introduction to Hacking, by Georgia Weidman, No Starch Press
3. Ethical Hacking and Penetration Testing Guide, by Rafay Baloch, CRC Press
4. Ethical Hacker's Penetration Testing Guide, by Samir Kumar Rakshit, BPB Publications
5. Learn Ethical Hacking from Scratch: Your stepping stone to penetration testing, by Zaid Sabih, Packt Publishing
6. Advanced Penetration Testing with Kali Linux: Unlocking Industry-Oriented Vapt Tactics, by Ummed Meel, BPB Publications
7. Web Penetration Testing with Kali Linux, 3e, by Juned Ahmed Ansari and Gilberto Najera-Gutierrez, Packt Publishing
8. Mastering Kali Linux for Web Penetration Testing, by Michael McPhee, Packt Publishing

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (CSE)	Data Science	CS-7021(C)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.

CO2 Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.

CO3 Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.

CO4 Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.

Course Contents:

UNIT I

Conceptualization and summarization: Representation of data. Modeling of machine learning techniques. Application of big data computing technologies.

UNIT II

Trivial data versus Big data: Representation learning. Publicly available datasets. Scalability and Scaling up techniques. Report writing using Latex.

UNIT III

Big data computing environment: Modern data analytics technologies like Hadoop and MapReduce. Suitable programming languages like Python, Java and C, Big data friendly machine learning scikit-learn, NumPy, Pandas, Matplotlib libraries. Software platforms like MATLAB or R

UNIT IV

Machine learning techniques: Three phases of machine learning. types of learning, support vector machine, decision trees and random forests, deep learning

UNIT V

Scaling up machine learning: Dimensionality reduction techniques like principal component analysis and feature hashing, Online processing technique called stochastic gradient descent, Big data machine learning models.

References:

1. Data Science From Scratch: First Principles with Python, 2e, by Joel Grus, O'Reilly Media
2. Introduction to Statistical Learning: with Applications in Python, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, and Jonathan Taylor, Springer
3. Python Data Science Handbook: Essential Tools for Working with Data, 2e, by Jake VanderPlas, O'Reilly Media
4. Data Science and Machine Learning using Python, by Dr Reema Thareja, McGraw Hill Education
5. Introduction to Data Science: Practical Approach with R and Python, by B. Uma Maheswari and R. Sujatha, Wiley
6. Big Data: Principles and Best Practices of Scalable Real-Time Data Systems, by Nathan Marz and James Warren, Manning
7. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools by Davy Cielen, Arno D.B. Meysman and Mohamed Ali, Manning
8. Big Data Analytics, by Raj Kamal, Preeti Saxena, McGraw Hill Education
9. Big Data Analytics 2e, by RadhaShankarmani, M. Vijaylakshmi, Wiley
10. Big Data with Hadoop MapReduce: A Classroom Approach, by Anand Paul, Ganeshkumar Pugalendhi and Rathinaraja Jeyaraj, CRC Press
11. Big Data and Analytics: The key concepts and practical applications of big data analytics, by Jugnesh Kumar, Anubhav Kumar and Rinku Kumar, BPB Publications
12. Big Data Analytics: Concepts, Techniques, Tools and Technologies, by G. Sudha, M. Thangaraj and S. Suguna, PHI Learning Pvt. Ltd.
13. Big Data and Analytics, 2e, by Seema Acharya and Subhashini Chellappan, Wiley
14. Big Data Big Analytics, by Michael Minelli, Michele Chambers and Ambiga Dhiraj, Wiley

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cryptography and Network Security	IOT-7031(A)	3L-0T-0P	3

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understanding of the basics of Cryptography and Network Security and working knowledge of Mathematics used in Cryptology.

CO2 Understanding of previous attacks on cryptosystems to prevent future attacks from securing a message over an insecure channel by various means.

CO3 Knowledge about how to maintain the Confidentiality, Integrity and Availability of a data.

CO4 Understanding of various protocols for network security to protect against the network threats.

CO5 Getting hands-on experience of various Information Security Tools.

Course Contents:

UNIT I

Mathematical Background for Cryptography: Abstract Algebra, Number Theory, Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem. Introduction to Cryptography: Principles of Cryptography, Classical Cryptosystem, Cryptanalysis on Substitution Cipher (Frequency Analysis), Play Fair Cipher, Block Cipher. Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher.

UNIT II

Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Discrete Logarithmic Problem, Diffie-Hellman Key Exchange Computational & Decisional Diffie-Hellman Problem, RSA Assumptions & Cryptosystem, RSA Signatures & Schnorr Identification Schemes, Primarily Testing, Elliptic Curve over the Reals, Elliptic curve Modulo a Prime., Chinese Remainder Theorem.

UNIT III

Message Authentication, Digital Signature, Key Management, Key Exchange, Hash Function. Universal Hashing, Cryptographic Hash Function, MD, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS), Cryptanalysis: Time-Memory Trade-off Attack, Differential Cryptanalysis. Secure channel and authentication system like Kerberos.

UNIT IV

Information Security: Threats in Networks, Network Security Controls–Architecture, Wireless Security, Honey pots, Traffic Flow Security, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security: Services Security for Email Attacks Through Emails, Privacy-Authentication of Source Message, Pretty Good Privacy (PGP), S-MIME. IP Security: Overview of IPSec, IP& IP version 6 Authentication, Encapsulation, Security Payload ESP, Internet Key Exchange IKE, Web Security: SSL/TLS, Basic protocols of security. Encoding –Secure Electronic Transaction SET.

UNIT V

Cryptography and Information Security Tools: Spoofing tools: like Arping etc., Foot printing Tools (ex- nslookup, dig, Whois etc..), Vulnerabilities Scanning Tools (i.e. Angry IP, HPing2, IP Scanner, Global Network Inventory Scanner, Net Tools Suite Pack.), NetBIOS Enumeration Using NetView Tool, Steganography Merge Streams, Image Hide, Stealth Files, Blindsideusing: STools, Steghide, Steganos. Stegdetect, Steganalysis - Stego Watch - Stego Detection Tool, StegSpy. Trojans Detection Tools (i.e. Netstat, fPort, TCPView, CurrPorts Tool, Process Viewer), Lan Scanner Tools (i.e.look@LAN, Wireshark, Tcpdump). DoS Attack Understanding Tools- Jolt2, Bubonic.c, Land and LaTierra, Targa, Nemesy Blast, Panther2, Crazy Pinger, Some Trouble, UDP Flood, FSMax.

References:

1. Cryptography and Network Security Principles and Practice 4e, by William Stallings, Pearson Education
2. Cryptography and Network Security, by Behrouz A Ferouzan, Tata McGraw Hill
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
4. Security in Computing, 4e, by Charles P. Pfleeger, Shari Lawrence Pfleeger, Prentice Hall of India
5. Introduction to Modern Cryptography by Jonathan Katz and Yehuda Lindell, Chapman and Hall/CRC Press
6. Cryptography and Network Security 4e, by Atul Kahate, McGraw Hill Education
7. Foundations of Cryptography: Volume 1, Basic Tools, by Oded Goldreich. Cambridge University Press
8. Understanding Cryptography: A Textbook for Students and Practitioners, by Bart Preneel, Christof Paar and Jan Pelzl, Springer
9. Real-World Cryptography, by David Wong, Manning
10. Cryptography and Network Security, by Savita Gandhi and Bhushan Trivedi, BPB Publications

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cyber Law	IOT-7031(B)	2L-1T-1P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Become aware of various cyber-crimes and cyber laws.

CO2 Underline the need of digital forensic and role of digital evidences.

CO3 Understand different types of digital evidences that can be presented to support investigations.

CO4 List the methods to generate legal evidence and supporting investigation reports.

CO5 Use various digital forensic tools.

Course Contents:

UNIT I

Introduction to cybercrime, definition, cyber-crime and information security, classification of cybercrimes, cybercrime: the legal perspectives, an Indian perspective, cybercrime and the Indian ITA 2000, a global perspective on cybercrime, Cyber offences: How criminals plan them, Tools and methods used in cyber-crime, Need of cyber law, The Indian IT act, challenges to Indian law and cybercrime scenario in India, digital signature and Indian IT act, Amendments in the Indian IT act, cybercrime and punishment

UNIT II

Law and framework for information security, law for intellectual property rights (IPR), patent law, copy right law, Indian copyright act, privacy issue and law in Hong Kong, Japan, and Australia, data protection act in Europe, health insurance portability and accountability act of 1996 (HIPAA), Gramm-leach-Bliley act of 999 (GLAB), Sarbanes-Oxley (SOX), legal issue in data mining, building security into software/system development life cycle

UNIT III

Digital forensics Science, The need for computer forensics, Understanding computer forensics, computer forensics versus other related disciplines, A brief History of computer Forensics, Cyber forensics and digital evidence, Digital forensics lifecycle, chain of custody concept, Network forensics, Approaching a computer forensics investigation, setting up a computer forensics laboratory, Forensics and social networking sites, computer forensics from compliance perspective, challenges in computer forensics, forensics auditing, antiforensics

UNIT IV

Current Computer Forensics Tools, Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools, Forensic Workstations

UNIT V

Forensics of hand held devices, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks ,Router Forensics. Cyber forensics tools and case studies.

References:

1. The Indian Cyber Law, by Suresh T. Vishwanathan, Bharat Law House
2. Information Technology Laws and Cyber Crimes, by Nirav Vithalani, Shashwat Publication
3. Cyber Security and Cyber Laws, by Nilakshi Jain and Ramesh Menon, Wiley
4. Fundamental of Cyber Security (Principles, Theory & Practices), by Mayank Bhushan, Rajkumar Singh Rathore, and Aatif Jamshed, BPB Publications
5. Digital Forensics with Open Source Tools, by Cory Altheide and Harlan Carvey, Syngress Media
6. Guide to Computer Forensics and Investigations, by Bill Nelson, Amelia Phillips, and Christopher Steuart, Cengage Learning Pvt. Ltd.
7. Digital Forensics: Digital Evidence in Criminal Investigation, by Angus M. Marshall, Wiley-Blackwell
8. The Cambridge Handbook of Digital Evidence in Criminal Investigations, by Vanessa Franssen and Stanislaw Tosza, Cambridge University Press

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Security and Privacy in IoT	IOT-7031(C)	3L-0T-0P	3

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the unique security and privacy challenges in IoT ecosystems

CO2 Analyze vulnerabilities in IoT devices, networks, and applications

CO3 Apply cryptographic and privacy-preserving techniques suitable for IoT systems

CO4 Evaluate IoT-specific security frameworks, standards, and regulatory requirements

CO5 Design secure and privacy-aware IoT architectures for real-world applications

Course Contents:

UNIT I

Introduction to IoT Security and Privacy: Overview of IoT architecture and components, Attack surfaces in IoT: device, network, data, application, Privacy concerns in IoT environments, Comparison with traditional IT security

UNIT II

Threat Modeling and Risk Assessment: Threat modeling techniques (STRIDE, DREAD), Common attacks: replay, eavesdropping, DoS, man-in-the-middle, Risk assessment methodologies for IoT, Secure design principles

UNIT III

Cryptography for IoT: Basics of cryptography: symmetric, asymmetric, hashing, Lightweight cryptography for resource-constrained devices, Key management in large-scale IoT deployments, Secure communication protocols: TLS, DTLS, IPsec, Identity and access management in IoT, Secure boot and firmware validation, Access control models (RBAC, ABAC), Biometric and token-based authentication

UNIT IV

Network Security for IoT: Securing IoT communication protocols (MQTT, CoAP, 6LoWPAN), Network segmentation and intrusion detection, Security in wireless communication: ZigBee, BLE, LoRaWAN, IoT-specific firewalls and gateways

Privacy-Preserving Techniques: Anonymization and data minimization, Differential privacy in sensor networks, Secure multi-party computation and homomorphic encryption, Privacy-by-design for IoT applications

UNIT V

Security Frameworks, Standards, and Regulations: Industry standards: ISO/IEC 27030, NIST IoT Framework, IEEE 2413, IoT Security Compliance (GDPR, HIPAA, etc.), Cloud and Edge security integration for IoT, Blockchain and DLT for secure IoT transactions

Applications: Smart home, healthcare, industrial IoT (IIoT) security scenarios, Security in autonomous vehicles and wearables, Recent IoT vulnerabilities and exploits, AI/ML for anomaly detection in IoT networks

References:

1. Internet of Things Security: Principles, Applications, Attacks, and Countermeasures, by Brij B. Gupta and Megha Quamara, CRC Press
2. Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem, 2e, by Brian Russell and Drew Van Duren, Packt Publishing
3. Security and Privacy Issues in IoT Devices and Sensor Networks, by Sudhir Kumar Sharma, Bharat Bhushan, and Narayan C. Debnath, Academic Press
4. Internet of Things Security and Privacy: Practical and Management Perspectives, by Ali Ismail Awad, Atif Ahmad, Kim-Kwang Raymond Choo, and Saqib Hakak, CRC Press
5. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, by Fei Hu, CRC Press
6. Security of Internet of Things Nodes: Challenges, Attacks, and Countermeasures, by Chinmay Chakraborty, Muhammad Habibur Rehman, and Sree Ranjani Rajendran, CRC Press
7. Privacy, Security and Forensics in The Internet of Things (IoT), by Reza Montasari, Fiona Carroll, Ian Mitchell, Sukhvinder Hara, and Rachel Bolton-King, Springer
8. Security and Privacy in the Internet of Things: Architectures, Techniques, and Applications, by Ali Ismail Awad and Jemal Abawajy, Wiley
9. Demystifying Internet of Things Security: Successful IoT Device/Edge and Platform Security Deployment, by Sunil Cheruvu, Anil Kumar, Ned Smith, and David M. Wheeler, Apress
10. Internet of Things: Security and Privacy in Cyberspace, by Ashok Kumar Pradhan and Sandeep Saxena, Springer

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Digital Forensics	IOT-8011	2L-1T-1P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the fundamentals, scope, and legal considerations of digital forensics

CO2 Identify and collect digital evidence in a forensically sound manner

CO3 Analyze file systems, operating systems, and network data for evidence of digital crimes

CO4 Utilize forensic tools and techniques to investigate compromised systems and networks

CO5 Apply procedures for mobile, cloud, and memory forensics

Course Contents:

UNIT I

Introduction to Digital Forensics: Definition, scope, and need for digital forensics, Types of digital crimes and evidence, Legal and ethical considerations (chain of custody, admissibility), Forensics process: identification, preservation, analysis, reporting

UNIT II

Digital Evidence and Investigation Procedures: Types of digital evidence (volatile vs. non-volatile), Evidence handling, documentation, and chain of custody, Imaging and hashing: dd, FTK Imager, write blockers, Live vs. dead forensics

UNIT III

File System and Operating System Forensics: FAT, NTFS, ext3/ext4 file systems, Recovering deleted files, metadata analysis, Windows registry and log analysis, Linux system artifacts

Disk and Memory Forensics: Disk structure and forensic imaging, Partition analysis and slack space investigation, RAM acquisition and memory dump analysis, Tools: Volatility, FTK, Autopsy, Sleuth Kit

UNIT IV

Network Forensics: Network traffic capture and analysis, Packet sniffing and session reconstruction, Firewall, router, and proxy logs, Intrusion detection/prevention system (IDS/IPS) forensics

Web, Email, and Cloud Forensics: Browser artifacts and cookie analysis, Email headers, attachments, and phishing detection, Forensics challenges in cloud environments, Cloud log analysis (AWS, Azure, Google Cloud basics)

UNIT V

Mobile Device Forensics: Mobile OS architecture (Android, iOS), SIM card and memory card analysis, Logical vs. physical extraction, Tools: Cellebrite, MOBILedit, XRY

Reporting and Expert Testimony: Forensic report writing and evidence presentation, Report structure and legal language, Role of digital forensics expert in court

References:

1. Guide to Computer Forensics and Investigations, by Bill Nelson, Amelia Phillips, and Christopher Steuart, Cengage India Pvt. Ltd.
2. Digital Forensics and Incident Response, by Gerard Johansen, Packt Publishing
3. Practical Digital Forensics, by Akashdeep Bhardwaj and Keshav Kaushik, BPB Publications
4. Digital Forensics for Enterprises Beyond Kali Linux, by Abhirup Guha, BPB Publications
5. Digital Forensics and Investigation Methods, by Padmavathi Ganapathi, Notion Press
6. Digital Forensic: The Fascinating World of Digital Evidences, by Nilakshi Jain and Dhananjay R. Kalbande, Wiley
7. Digital Forensics and Incident Response, by Deepanshu Khanna, BPB Publications
8. Guide to Digital Forensics: A Concise and Practical Introduction, by Joakim Kävrestad, Springer
9. Mastering Network Forensics, by Nipun Jaswal, BPB Publications
10. Digital Forensics and Cyber Investigation, by Kyung-Shick Choi, Sinchul Back, and Marlon Mike Toro Alvarez, Cognella Academic Publishing
11. Cyber Forensics Up and Running: A hands-on guide to digital forensics tools and technique, by Tarun Vashishth, BPB Publications
12. The Basics of Digital Forensics, by John Sammons, Syngress

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Smart City using IoT	IOT-8021(A)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the concept, architecture, and components of a smart city ecosystem

CO2 Analyze how IoT technologies enable intelligent urban infrastructure and services

CO3 Design and develop IoT-based applications for key smart city domains (transport, energy, waste)

CO4 Evaluate data management, interoperability, and scalability challenges in smart cities

CO5 Apply security, privacy, and sustainability principles in smart city design

Course Contents:

UNIT I

Introduction to Smart Cities: What makes a city "smart", Components and layers of a smart city, IoT role in smart cities, Global smart city initiatives (Singapore, Barcelona, Amsterdam), Indian smart city initiatives, **Smart City Architecture and Technologies:** IoT architecture for smart cities (sensors, network, cloud/edge, application), Communication technologies: Wi-Fi, LPWAN, LoRaWAN, 5G, Cloud, edge, and fog computing in smart cities, Interoperability and standardization (IEEE, ITU, oneM2M)

UNIT II

Smart City Applications: Smart Transportation: Intelligent traffic management, smart parking, public transit tracking, Smart Energy: Smart grids, smart metering, renewable integration, Smart Water Management: Leak detection, usage analytics, Smart Waste Management: Bin monitoring, route optimization, Smart Buildings & Homes: HVAC, lighting, security, smart CCTV implementation, Smart Governance & e-Services: Citizen engagement platforms, digital identity

UNIT III

Sensing, Data Acquisition, and Analytics: IoT sensors for environment, mobility, and infrastructure, Real-time data collection and transmission, Big data analytics and AI for urban intelligence, Visualization tools and dashboards

UNIT IV

IoT Platforms and Prototyping: Platforms: Arduino, Raspberry Pi, NodeMCU, ESP32, IoT cloud services: AWS IoT, ThingsBoard, Google Cloud IoT, Open-source smart city platforms (FIWARE, OpenHAB), Building and testing a small-scale smart city prototype

UNIT V

Security, Privacy, and Sustainability: Security challenges in smart city IoT systems, Data privacy, anonymization, and citizen trust, Energy-efficient design and environmental impact, Ethical and legal considerations, **Standards:** Smart city solutions in India (Smart Cities Mission), International standards (ISO 37120, ITU-T Y.4208), Public-private partnerships in smart city projects, Lessons learned from global deployments

References:

1. Smart Cities: The Internet of Things, People and Systems, by Schahram Dustdar, Stefan Nastić, and Ognjen Šćekić, Springer
2. Smart Cities: Foundations, Principles, and Applications, by Houbing Song, Ravi Srinivasan, Tamim Sookoor, and Sabina Jeschke, Wiley
3. IoT for Sustainable Smart Cities and Society, by Joel J. P. C. Rodrigues, Kavita Khanna, and Parul Agarwal, Springer
4. Internet of Things for Smart Cities, by Waleed Ejaz and Alagan Anpalagan, Springer
5. Smart Cities and the Internet of Things: The Evolution of Cities, by Kannimuthu Subramaniyam and Marcin Paprzycki, Springer
6. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, by Surjeet Dalal, Vivek Jaglan, and Dac-Nhuong Le, CRC Press
7. Internet of Things for Smart Cities: Technologies, Big Data and Security, by Waleed Ejaz and Alagan Anpalagan, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Blockchain Technologies	IOT-8021(B)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Explain cryptographic building blocks and reason about their security.

CO2 Learn how the individual components of the Bitcoin protocol make the whole system works transactions, script, blocks, and the peer-to-peer network.

CO3 Define how Bitcoin mining works.

CO4 Exploit applications of Blockchain in real world sceneries.

Course Contents:

UNIT I

Introduction: Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Blockchain, Understanding Cryptocurrency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain; Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

UNIT II

Understanding Blockchain with Cryptocurrency: Bitcoin and Blockchain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hash Cash PoW, Bit coin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

UNIT III

Understanding Blockchain for Enterprises: Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain - Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

UNIT IV

Enterprise Application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, and Identity on Blockchain.

UNIT V

Blockchain Application Development: Hyperledger Fabric - Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

References:

1. Blockchain Technology: From Theory to Practice, by Sudeep Tanwar, Springer
2. Blockchain Technology, by Kumar Saurabh and Ashutosh Saxena, Wiley
3. Blockchain in Action, by Bina Ramamurthy, Manning
4. Mastering Blockchain: Inner Workings of Blockchain, from Cryptography and Decentralized Identities, to DeFi, NFTs and Web3, by Imran Bashir, Packt Publishing Ltd.
5. Blockchain Technology: Algorithms and Applications, by S. Asharaf, Neelima Sivadas, S. Adarsh, John Franklin, Wiley
6. Blockchain Essentials You Always Wanted to Know, by Kancharla, Vibrant Publishers
7. Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, by Lorne Lantz and Daniel Cawrey, O'Reilly Media
8. Blockchain Essentials: Core Concepts and Implementations, by Ramchandra Sharad Mangrulkar and Pallavi Vijay Chavan, Apress
9. Grokking Bitcoin, by Kalle Rosenbaum and David A. Harding, Manning
10. Mastering Bitcoin: Programming the Open Blockchain, 2e, by Andreas M. Antonopoulos, O'Reilly Media
11. Blockchain: Blueprint for a New Economy, by Melanie Swan, O'Reilly Media
12. Blockchain Basics: A Non-Technical Introduction in 25 Steps, by Daniel Drescher, Apress

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Robotics	IOT-8021(C)	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand robot mechanism.

CO2 Perform kinematic and dynamic analyses with simulation.

CO3 Design control laws for a robot.

CO4 Understand robot mechanism Integrate mechanical and electrical hardware for a real prototype of robotic device.

Course Contents:

UNIT I

Introduction to Robotics: Types and components of a robot, Classification of robots, closed-loop and open-loop control systems; Kinematics systems: Definition of mechanisms and manipulators, Social issues and safety

UNIT II

Robot Kinematics and Dynamics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH (Denavit-Hartenberg) parameters, Jacobian, Singularity, and Statics; Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

UNIT III

Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/ Similarity/ Affine/ Projective transformations, Vision applications in robotics.

UNIT IV

Robot Control: Basics of control: Transfer functions, Control laws: P, PD, PID, Non-linear and advanced controls Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

UNIT V

Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications

References:

1. Introduction to Robotics, 3e, by S.K. Saha, McGraw Hill Higher Education
2. Robotics: Fundamental Concepts and Analysis, by Ashitava Ghosal, Oxford University Press
3. Introduction to Robotics: Analysis, Systems, Applications, by Saeed B. Niku, Pearson Education
4. Robotics and Control, by R.K. Mittal and I.J. Nagrath, McGraw Hill Education
5. Introduction to Robotics: Mechanics and Control, by John Craig, Pearson Education
6. Robot Modelling and Control, by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, John Wiley and Sons Inc,
7. Intelligent Mechatronic System: Modeling, Control and Diagnosis, by R. Merzouki, A.K. Samantaray, P.M. Phathak, and B. Ould Bouamama, Springer
8. Embedded System Design, 2e, by Steve Heath, Newnes
9. Elements of Robotics, by Mordechai Ben-Ari and Francesco Mondada, Springer

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Cognitive IoT	IOT-8031(A)	3L-0T-0P	3

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the fundamental principles and architecture of Cognitive IoT systems

CO2 Explain how cognition enhances the functionality, autonomy, and intelligence of IoT systems

CO3 Apply machine learning and AI techniques to enable context-awareness, perception, and decision-making in IoT

CO4 Design intelligent, adaptive, and learning-based IoT applications using cognitive frameworks

CO5 Analyze real-world use cases and challenges in deploying cognitive IoT solutions

Course Contents:

UNIT I

Introduction to Cognitive IoT: Evolution - From IoT to Cognitive IoT, Definition and key characteristics of Cognitive IoT, Cognitive IoT vs traditional IoT and AIoT, Applications: smart cities, healthcare, industry, agriculture

UNIT II

Architecture and Enabling Technologies: Cognitive IoT reference architecture, Integration of sensing, perception, reasoning, and learning, Enabling technologies: AI, edge computing, semantic computing, Middleware platforms for Cognitive IoT

UNIT III

Perception and Context Awareness: Sensor data processing and fusion, Context modeling and reasoning, Ontologies and semantic web for IoT, Tools: Protégé, RDF, OWL, SPARQL

Machine Learning in IoT: Supervised, unsupervised, and reinforcement learning in IoT, Lightweight ML models for edge devices, Online learning and concept drift in IoT environments, Tools: TensorFlow Lite, Edge Impulse, TinyML

UNIT IV

Cognitive Communication and Decision Making: Cognitive radio and dynamic spectrum access, Autonomous decision making in IoT systems, Federated learning and decentralized intelligence, Decision trees, fuzzy logic, and rule-based systems

Cognitive Cloud and Edge Integration: Edge-cloud collaboration for learning and control, Cognitive services: Microsoft Azure Cognitive Services, IBM Watson IoT, Intelligent agents and multi-agent systems, Real-time event-driven architecture

UNIT V

Security and Ethics in Cognitive IoT: Trust, transparency, and explainable AI in IoT, Security threats and defense mechanisms, Ethical concerns and AI bias, Data governance in cognitive environments, Smart healthcare, Smart agriculture (context-aware irrigation systems), Intelligent transportation (adaptive traffic systems)

References:

1. Cognitive Internet of Things, by Pethuru Raj, Anupama C. Raman, and Harihara Subramanian, CRC Press
2. Cognitive Internet of Things: Frameworks, Tools and Applications, by Huimin Lu, Springer
3. Towards Cognitive IoT Networks, by Mohammad Abdul Matin, Springer
4. Cognitive (Internet of) Things, by Arvind Sathi, Palgrave Macmillan

R.K.D.F. UNIVERSITY, BHOPAL
B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Game Theory with Engineering Applications	IOT-8031(B)	3L-0T-0P	3

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Formulate and analyze strategic interactions using game-theoretic models.

CO2 Apply solution concepts like Nash Equilibrium.

CO3 Apply Subgame Perfect Equilibrium, and Bayesian Equilibrium in engineering.

CO4 Evaluate applications in auctions, negotiation, market competition, and engineering.

Course Contents:

UNIT I

Introduction: Game Theory, Strategic form (normal form) games, Dominant strategies, dominated strategies, Nash Equilibrium (pure strategies), Applications: Market entry, coordination games

UNIT II

Mixed Strategies: Dynamic Games of Perfect Information, Mixed Strategy Nash Equilibrium, Expected utility and randomization, Extensive form games, Subgame Perfect Equilibrium (SPE), Backward induction, Applications: Sequential games, trust games

UNIT III

Repeated and Evolutionary Games: Repeated games (finite and infinite horizon), Grim trigger and tit-for-tat strategies, Folk Theorem and strategic enforcement, Evolutionary game theory basics, Applications: Cooperation, collusion

UNIT IV

Bayesian Games: Static games with incomplete information, Bayesian Nash Equilibrium, Auctions: First-price, second-price, common vs private value, Signaling and Screening models, Applications: Job market signaling, insurance, political games

UNIT V

Cooperative Games and Mechanism Design: Cooperative games: Core, Shapley value, Bargaining models (Nash bargaining solution), Mechanism design: Incentive compatibility, Revelation Principle, Vickrey–Clarke–Groves (VCG) mechanisms, Social choice and voting mechanisms

References:

1. An Introduction to Game Theory, by Martin J. Osborne, Oxford University Press,
2. Mathematical Game Theory, by Ulrich Faigle, World Scientific Publishing
3. A Course in Game Theory, by Thomas S Ferguson, World Scientific Publishing
4. Mathematical Game Theory and Applications, by Mazalov, Wiley
5. Game Theory An Introduction, by Steven Tadelis, Princeton University Press
6. Introduction to Game Theory, by Stef Tijs, Eurospan
7. Game Theory: A Modeling Approach, by Richard Alan Gillman and David Housman, CRC Press
8. Game Theory: Understanding the Mathematics of Life, by Brian Clegg, Icon Books
9. Insights into Game Theory: An Alternative Mathematical Experience, by Ein-Ya Gura and Michael Maschler, Cambridge University Press
10. Game Theory: A Beginner's Guide to Game Theory Mathematics, Strategy & Decision-Making, by John Cummings, Ingram Publishing
11. An Introductory Course on Mathematical Game Theory and Applications, by Julio Gonzalez-Diaz and Ignacio Garcia-Jurado, American Mathematical Society
12. Algorithmic Game Theory, by Noam Nisan, Tim Roughgarden, Eva Tardos and Vijay V. Vazirani, Cambridge University Press

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B.TECH (CSE - Internet of Things and Cyber Security including Blockchain Technology)
FOURTH YEAR, Semester – VII
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
B.TECH (IOT)	Bitcoin and Cryptocurrency Technology	IOT-8031(C)	3L-0T-0P	3

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand the design principles, motivations, and architecture of Bitcoin and other cryptocurrencies

CO2 Analyze the cryptographic techniques and consensus mechanisms used in blockchain systems

CO3 Explore the technical, economic, and societal impacts of cryptocurrencies

CO4 Develop blockchain-based applications and interact with cryptocurrency networks programmatically

CO5 Evaluate security threats, privacy concerns, and regulatory implications in cryptocurrency ecosystems

Course Contents:

UNIT I

Introduction to Cryptocurrencies: History and evolution of digital currencies, Bitcoin, The problem of trust and centralization, Overview of the cryptocurrency ecosystem, Key concepts: decentralization, digital scarcity, consensus, pseudonymity

Bitcoin in Depth: Bitcoin architecture and components, Transactions, blocks, and addresses, The Bitcoin network and peer-to-peer model, Proof-of-Work consensus and mining

UNIT II

Cryptographic Foundations: Hash functions (SHA-256), Merkle trees, public key cryptography and digital signatures (ECDSA), Wallets and key management, Bitcoin Script and transaction verification

Blockchain Technology: Structure and properties of a blockchain, Distributed ledger and immutability, Forks (soft and hard), Scalability issues (block size debate, Layer 2 solutions)

UNIT III

Altcoins and Smart Contracts: Overview of Ethereum and smart contract platforms, ERC-20 tokens and Dapps, Comparison of consensus algorithms: PoW, PoS, DPoS, Stablecoins, privacy coins (Monero, Zcash), **Security, Privacy, and Anonymity:** Attacks on blockchain systems (51% attacks, double spending, Sybil attacks), Privacy techniques (mixers, CoinJoin, zk-SNARKs), Security of wallets, exchanges, and DeFi platforms, Regulatory challenges and compliance (KYC/AML)

UNIT IV

Cryptocurrency Economics and Incentives: Game theory and incentives in blockchain protocols, Tokenomics and monetary policy of cryptocurrencies, Market dynamics, valuation models, ICOs, DAOs, and crypto investment risks

UNIT V

Applications: Real-world use cases: remittances, supply chain, NFTs, CBDCs, Layer 2 solutions: Lightning Network, rollups, Blockchain interoperability and cross-chain communication, NFT (non-fungible token) and Web3

References:

1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Princeton University Press
2. Mastering Bitcoin: Programming the Open Blockchain, 2e, by Andreas M. Antonopoulos, Shroff/O'Reilly
3. Bitcoin and Cryptocurrency Technologies, by Keizer Söze, Sabi Shepherd Ltd.
4. Bitcoin and Cryptocurrency Technologies, by Cliff Davison, Notion Press
5. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them, by Antony Lewis. Mango
6. Cryptocurrency Concepts, Technology, and Applications, by Jay Liebowitz, CRC Press
7. Bitcoin Blockchain: Protocol for Micropayments, by Kapil Jain, BPB Publications
8. Blockchain and DLT: A comprehensive guide to getting started with blockchain and Web3, by Nakul Shah, BPB Publications
9. Exploring Bitcoin with Blockchain: Adopt Bitcoin to Reinvent Business Scaling with Lower Transaction Costs and Better Fraud Prevention, by Vizeet Srivastava, BPB Publications