DEPARTMENT OF INFORMATION TECHNOLOGY

# DELHI TECHNOLOGICAL UNIVERSITY

**B.Tech. (Information Technology) revised syllabus in compliance with NEP 2020**

# Abbreviations

A. AEC: Ability Enhancement Course
B. BSC: Basic Science Courses
C. ESC: Engineering Science Course
D. DCC: Discipline Specific Core Course
E. DEC: Discipline Specific Elective Course
F. GEC: Generic Elective Course
G. SEC: Skill Enhancement Course
H. VAC: Value Addition Course

## FIRST YEAR

| First semester | | | |
|---|---|---|---|
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Mathematics-I | 4 | BSC |
| 2. | Physics/Programming Fundamentals | 4 | BSC/ESC |
| 3. | Interdisciplinary Course -1 [**Basic Electrical Engineering**] | 4 | BSC/ESC |
| 4. | Interdisciplinary Course -2 [**Basic of Electronics & Communication**] | 4 | BSC/ESC |
| 5. | Skill Enhancement Course -1 [**Fundamentals of Web Design]** | 2 | SEC |
| 6. | Ability Enhancement Course-I | 2 | AEC |
| | **Total** | **20** | |
| **Second semester** | | | |
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Mathematics-II | 4 | BSC |
| 2. | Programming Fundamentals/Physics | 4 | ESC/BSC |
| 3. | Interdisciplinary Course -3 [**Discrete Structures**] | 4 | BSC/ESC |
| 4. | Department Core Course-1 [**Object Oriented Programming**] | 4 | BSC/ESC |
| 5. | Skill Enhancement Course -2 [**Open Source Programming**] | 2 | SEC |
| 6. | Ability Enhancement Course-II | 2 | AEC |
| | **Total** | **20** | |

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## SECOND YEAR

| Third semester | | | |
|---|---|---|---|
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Interdisciplinary Engineering Science Course-1 [**Digital Systems and Microcontrollers**] | 4 | ESC |
| 2. | Department Core Course-2 [**Data Structures**] | 4 | DCC |
| 3. | Department Core Course-3 [**Data Science and Visualization**] | 4 | DCC |
| 4. | Department Core Course-4 [**Data Communications**] | 4 | DCC |
| 5. | Department Core Course-5 [**Theory of Computation]** | 4 | DCC |
| 6. | Value Addition Course-1 [**FEC11/FEC18/FEC28/FEC56/FEC57/FEC9**] | 2 | VAC |
| | **Total** | **22** | |
| **Fourth semester** | | | |
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Interdisciplinary Engineering Science Course-2 [**Software Engineering**] | 4 | ESC |
| 2. | Department Core Course-6 [**Algorithm Design and Analysis**] | 4 | DCC |
| 3. | Department Core Course-7 [**Operating Systems**] | 4 | DCC |
| 4. | Department Core Course-8 [**Database Management Systems**] | 4 | DCC |
| 5. | Department Core Course-9 [**Machine Learning**] | 4 | DCC |
| 6. | Value Addition Course-2 [**FEC11/FEC18/FEC28/FEC56/FEC57/FEC9**] | 2 | VAC |
| | **Total** | **22** | |

DEPARTMENT OF INFORMATION TECHNOLOGY

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## THIRD YEAR

| Fifth semester | | | |
|---|---|---|---|
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Department Core Course-10 [**Compiler Design**] | 4 | DCC |
| 2. | Department Core Course-11 [**Computer Networks**] | 4 | DCC |
| 3. | Department Core Course-12 [**Computer Organization and Architecture**] | 4 | DCC |
| 4. | Engineering Economics/Fundamentals of Management | 3 | SEC |
| 5. | **Department Elective Course-1**<br>I. Deep Learning<br>II. Cyber Laws<br>III. Malware Analysis<br>IV. Internet of Things<br>V. Computer Graphics<br>VI. Software Project Management | 4 | DEC |
| 6. | **Generic Elective Course-1**<br>I. Data Structures and Algorithms<br>II. Information and Network Security<br>III. Introduction to Computer Networks<br>IV. Computer Architecture<br>V. Introduction to Database Systems<br>VI. Computer Vision and Applications | 4 | GEC |
| | **Total** | **23** | |
| **Sixth semester** | | | |
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1. | Department Core Course-13 [**Data Engineering and Analytics**] | 4 | DCC |
| 2. | Department Core Course-14 [**Cyber Security**] | 4 | DCC |
| 3. | Fundamentals of Management/ Engineering Economics | 3 | SEC |
| 4. | **Department Elective Course-2** | 4 | DEC |
| 5. | **Department Elective Course-3** | 4 | DEC |
| 6. | **Generic Elective Course-2**<br>I. Deep Learning Applications<br>II. Introduction to JAVA programming<br>III. Operating System Principles<br>IV. Data Analysis using R<br>V. Dependable Machine Learning<br>VI. Embedded Systems | 4 | GEC |
| | **Total** | **23** | |

| **List of Department Elective Course-2,3 (Sixth Semster)** | DEC |
|---|---|
| 1. Distributed and Cloud Computing<br>2. Pattern Recognition<br>3. Secure Coding<br>4. Wireless Ad hoc Mobile Networks<br>5. Blockchain Technology<br>6. Digital Image Processing<br>7. Natural Language Processing<br>8. Cyber and Digital Forensics<br>9. Computer Vision<br>10. Artificial Intelligence<br>11. Software Testing<br>12. Competitive Programming | |

## FOURTH YEAR

| **Seventh semester** | | | |
|---|---|---|---|
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1 | B.Tech Project-I | 4 | DCC |
| 2 | Internship | 2 | DCC |
| 3 | **Department Elective Course-4** | 4 | DEC |
| 4 | **Department Elective Course-5** | 4 | DEC |
| 5 | **Generic Elective Course-3**<br>I. Introduction to Cyber and Physical Systems<br>II. Data Warehousing and Data Mining<br>III. Game Theory<br>IV. Information Theory and Coding<br>V. Pattern Recognition and Applications<br>VI. Grid and Cluster Computing | 4 | GEC |
| 6 | Indian Knowledge Systems | NC | VAC |
| | **Total** | **18** | |

| **List of Department Elective Course 4,5(Seventh Semester)** | DEC |
|---|---|
| 1. Social Networks<br>2. Intrusion Detection and Information Warfare<br>3. High Performance Computing<br>4. High Speed Networks<br>5. Information Security and Audit<br>6. Multimedia System Design<br>7. Multimodal Data Processing<br>8. Big Data Analysis<br>9. Mobile and Digital Forensics<br>10. Soft Computing<br>11. Augmented Reality & Virtual Reality<br>12. Enterprise JAVA | |

| | | | |
|---|---|---|---|
| | | | |
| **Eighth semester** | | | |
| **S. No.** | **Subject** | **Credits** | **Category** |
| 1 | B.Tech Project-II | 8 | DCC |
| 2 | **Department Elective Course-6**<br>I. Speech and Natural Language Understanding<br>II. Ethical Hacking<br>III. Quantum Computing<br>IV. GPU Computing<br>V. Autonomous Systems and Robotics<br>VI. Semantic Web and Web Mining | 4 | DEC |
| 3 | **Generic Elective Course-4**<br>I. Mobile Application Development<br>II. Edge and Fog Computing<br>III. Cognitive Computing<br>IV. Neuromorphic Computing<br>V. Optimization Techniques<br>VI. Pervasive and Ubiquitous Computing | 4 | GEC |
| | **Total** | **16** | |
| **Cumulative credits** | | **164*** | |

- The total 164 as described above and additional 02 credits are to be earned from mandatory community engagement courses in the first year to fulfill the requirement of award of the four year B.Tech. degree.

NC: Non Credit

# FIRST SEMESTER

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| Fundamentals of Web Design | **L** | **T** | **P** | |
| | **1** | **0** | **2** | **-** |

**Course Objectives:**1. Develop the skill & knowledge of Web page design.
2. Students will understand the knowhow and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Define the principle of Web page design |
| **CO2** | Visualize the basic concept of HTML. |
| **CO3** | Recognize the elements of HTML |
| **CO4** | Apply basics concept of CSS for styling the pages |
| **CO5** | Develop the concept of web publishing |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Internet and HTML: WWW, Browser, URL, Web server, Web site, Domain Name, Basic principles involved in developing a web site, designing a web page, Page Layout, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags. | **9** |
| **UNIT 2** | Elements of HTML: Introduction, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls | **9** |
| **UNIT 3** | Introduction to Cascading Style Sheets: Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling, Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, CSS Colour, Creating page Layout and Site Designs. | **9** |
| **UNIT 4** | Introduction to Web Publishing or Hosting: Creating the Web Site, Saving the site, working on the web site, creating web site structure, Creating Titles for web pages, Themes-Publishing web sites. | **9** |
| | **TOTAL** | **36** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | HTML 5 in simple steps, Kogent Learning Solutions Inc, Dreamtech Press | |
| 2 | Beginner's Guide to HTML, Michael Gabriel | |
| 3 | Beginning HTML, XHTML, CSS, and JavaScript, John Duckett, Wiley India | |
| 4 | Beginning CSS: Cascading Style Sheets for Web Design, Ian Pouncey, Richard York, Wiley India | |

| | | |
|---|---|---|
| 5 | HTML, XHTML, and CSS Bible, 5ed, Steven M. Schafer, Wiley India | |

## SECOND SEMESTER

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| Discrete Structures | **L** | **T** | **P** | |
| | **1** | **1** | **0** | **-** |

**Course Objectives:1.** Learn the Concepts of Formal Logics.
2. Appraise the need for properties of relations, functions, and sequences to complete operations on discrete structures such as sets, functions, relations, and sequences.
3. Appraise the need for mathematical proofs using counter-examples, direct proofs, proof by contrapositive, proof by contradiction, case analysis, and mathematical induction.
4. Illustrate the use of Lattices and Boolean Algebra.
5. Demonstrate the use of Graph Theory.
6. Demonstrate the use of counting techniques and combinatorics to determine the discrete probability

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Apply the properties of relations, functions, and sequences to complete operations on discrete structures such as sets, functions, relations, and sequences. |
| **CO2** | Verify the correctness of an argument using propositional logic, predicate logic, and truth tables |
| **CO3** | Construct mathematical proofs using counter-examples, direct proofs, proof by contrapositive, proof by contradiction, case analysis, and mathematical induction |
| **CO4** | Apply counting techniques and combinatorics to determine discrete probability |
| **CO5** | Model relationships using graphs and trees |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | IFormal Logic: Statement, Symbolic Representation and Tautologies, Quantifiers, Predicator and validity, Normal form, Prepositional Logic, Predicate Logic, Logic Programming and Proof of correctors | **3** |
| **UNIT 2** | Proof, Relation and Analysis of Algorithm: Technique for theorem proving: Direct Proof, Proof by Contra position, proof by exhausting cases and proof by contradiction, Principle of mathematical induction, principle of complete induction, recursive definition, solution methods for linear, first-order recurrence relations with constant coefficients, analysis of algorithms involving recurrence rotations-recursive selection sort, binary search, quick sort, solution method for a divide-and-conquer recurrence relation. | **7** |
| **UNIT 3** | Sets and Combinations: Sets, Subsets, power sets, binary and unary operations on a set, set operations/set identities, fundamental counting principles, principle of inclusion, exclusion and pigeonhole, permutation and combination, Pascal's triangles, binomial theorem, representation of discrete structures. | **8** |
| **UNIT 4** | Relation/function and matrices: Rotations, properties of binary rotations, operation on b equivalence relation, properties of function, composition of function, inverse, binary ar function, composition of cycles, Boolean matrices, Boolean matrices multiplication. | **8** |

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|---|---|---|
| UNIT 5 | Lattices & Boolean Algebra:<br>Lattices: definition, sublattices, direct product, homomorphism<br>Boolean algebra: Definition, properties, isomorphic structures (in particular, structures with binary operations) subs algebra, direct product and homomorphism, Boolean function, Boolean expression, representation & minimization of Boolean function. | **8** |
| UNIT 6 | Graph Theory<br>Terminology, isomorphic graphs, Euler's formula (Proof) four color problem and the chromatic number of a graph, five color theorem.<br>Trees terminology, directed graphs, Computer representation of graphs, Warshall's algorithms, Decision Trees, Euler path & Hamiltonian circuits,<br>Shortest path & minimal spanning trees, Depth-first and breadth first searches, analysis of search algorithm, trees associated with DFS<br>& BFS Connected components, in order, preorder & post order tree traversal algorithms. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| 1 | Kenneth H. Rosen, "Discrete Mathematics and Its Applications", TMH (ISBN: 9780070681880),1999 | 1999 |
| 2 | C.L. Liu, "Elements of Discrete Mathematics", TMH (ISBN: 9780007043477), 2000 | 2000 |
| 3 | Kolman, Busby & Ross, "Discrete Mathematical Structures", PHI (ISBN- 978-0132297516),1996 | 1996 |
| 4 | NarsinghDeo, "Graph Theory With Application to Engineering and Computer Science", PHI (ISBN: 9788120301450),2004 | 2004 |
| 5 | J. P. Trembly& P. Manohar, "Discrete Mathematical Structures with Applications Computer Science", McGraw Hill (ISBN: 0070651426),1997 | 1997 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| Object-Oriented Programming | **L** | **T** | **P** | **-** |
| | **3** | **0** | **2** | |

**Course Objectives:**1.To understand the basics of classes and objects.
2.To provide knowledge of Object-Oriented programming features.
3.To understand the concept of operator overloading and inheritance
4.To understand the concept of exception handling, Input-Output and File Operation

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To differentiate between structured and object-oriented programming |
| **CO2** | To apply the concepts of Constructor, destructor, friend functions and classes and dynamic objects |
| **CO3** | To investigate cases of operator overloading, inheritance and abstraction |

| | |
|---|---|
| **CO4** | To implement generic programming with templates |
| **CO5** | To investigate Byte code, casting and conversion and input-output |
| **CO6** | To explain access specifiers, polymorphism and STL |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Object oriented paradigm & C++ at a glance: Evolution of programming paradigm, structured versus object-oriented development, elements of object-oriented programming, Objects, classes, methods, popular OOP languages, software reuse.<br>Classes and objects: Introduction, Class revisited, constant objects and constructor, static data members with constructors and destructors, constructor overloading, nested classes, objects as arguments, returning objects, friend functions and friend classes, constant parameters and member functions, static data and member functions. | **9** |
| **UNIT 2** | Dynamic objects: Introduction, pointers to objects, array of objects, pointers to object members, this pointer, self-referential classes<br>Operator overloading and Inheritance: overloading of new and delete operators, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions, abstract classes, inheritance types, virtual base classes, virtual functions, pointer to derived class objects, and base class objects, pure virtual functions, virtual destructors | **10** |
| **UNIT 3** | Generic programming with templates: Introduction, function templates, overloaded function templates, class templates, inheritance of class template, class template containership, class template with overloaded operators | **6** |
| **UNIT 4** | Introduction to byte code, security and portability, Data Types, variables, operators, arrays, type conversion and casting, type promotion, Control statements, standard input-output, Designing Classes, constructors, methods,<br>Access specifiers: public, private, protected, inheritance, packages and interfaces, Math, String, Vectors, and Array List classes, polymorphism: function and operator overloading, function overriding, abstract classes | **8** |
| **UNIT 5** | Exception Handling: exception types, nested try-catch, throw, throws and finally, statements, Multithread Programming: thread creation, synchronization and priorities. Input-output and file operations: Java.io, stream classes, Byte streams, character streams, serialization. | **8** |
| | **TOTAL** | **36** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | Patrick Naughton, Herbert Schildt: “The Complete Reference: Java 2”, 12th Edition, TMH.ISBN- 978-1260463415, McGraw Hill publisher, December 2021 | 2021 |
| 2 | C Thomas Wu : “An Introduction to OO programming with Java”, TMH, ISBN-10: 0073523305 | |
| 3 | Balaguruswami, “Object oriented with C++”, 8th Edition, TMH, 2020 ISBN 978-9389949186, McGraw Hill publisher, September 2020 | 2020 |
| 4 | Budd, “Object Oriented Programming”, Addison Wesley | |
| 5 | Mastering C++ K.R Venugopal Rajkumar, TMH. | |

| | | |
|---|---|---|
| 6 | D Samantha, “Object oriented Programming in C++ and Java “, PHI. | |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| Open-Source Programming | **L** | **T** | **P** | **-** |
| | **1** | **0** | **2** | |

**Course Objectives:**1. Learn the syntax and semantics of Python Programming Language.
2. Write Python functions to facilitate code reuse and manipulate strings.
3. Illustrate the process of structuring the data using lists, tuples, and dictionaries.
4. Demonstrate the use of built-in functions to navigate the file system.
5. Appraise the need for working on web scraping
6. Appraise the need for extracting data from various file formats.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Demonstrate the concepts of control structures in Python |
| **CO2** | Implement Python programs using functions and strings |
| **CO3** | Implement methods to create and manipulate lists, tuples, and dictionaries |
| **CO4** | Apply the concepts of file handling and regex using packages |
| **CO5** | Illustrate the working of scraping websites with CSV. |
| **CO6** | Illustrate the working of dealing with data in various types of files such as Excel, CS, PDF and JSON |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Python Basics: Entering Expressions into the interactive shell, The integer, floating and string data types, string concatenation and replication, storing values in variables, your first Python program.<br>Flow Control: Boolean Values, comparison operators, Boolean Operators, flow control statements, Importing Modules.<br>Functions: definition statement with parameters, Range values, and return values, The none value, Keyword arguments with printf(), Local and Global scope, The global statement, and Exceptional Handling | **9** |
| **UNIT 2** | LISTS: The list data type, working with lists, Augmented assignment operator, and List Methods.<br>Dictionary: The Dictionary Data-Type, Using Dictionary to Model real-world Things like a tic-tact toe board, Nested Dictionary, and Lists.<br>Manipulating Strings: Working with strings, Useful string Methods | **9** |
| **UNIT 3** | Pattern Matching with Regular Expression: Finding Patterns of text without regular expression, Finding Patterns of text with regular expression, Greedy, and Non-Greedy Matching, The findall() method.<br>Reading and Writing Files: File and File Paths, The os.path module, The file reading or writing process,.<br>Web Scrapping: maplt.py with the browser model, Downloading files from the web with request module, parsing HTML with beautiful soap module. | **9** |

| | | |
|---|---|---|
| **UNIT 4** | Working with Excel Spread Sheets: Installing the openpyxl module, Reading Excel documents, and writing Excel documents.<br>Working with PDF and Word Documents: creating PDF, Extracting text from PDF, Reading and writing Word documents.<br>Working with CSV files and JSON Data: The CSV module (Reading objects and Writing objects), JSON module ( Reading JSON and Writing JSON). | **9** |
| | **TOTAL** | **36** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| 1 | Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990 | 2015 |
| 2 | Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755 | 2015 |
| 3 | Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014. | |

# THIRD SEMESTER

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Digital Systems and Microcontroller** | **L** | **T** | **P** | **Basic Eectronics** |
| | **3** | **0** | **2** | |

**Course Objectives:** 1. To provide the basic knowledge of gates, Number Systems and their Arithmetic, Computer Codes, digital logic families, SOP and POS simplifications.
2. Ability to design MSI/LSI circuits.
3. Gain Knowledge about the function of Flip-Flops, Counters, Registers.
4. Understanding the concepts of Sequential circuits.
5. Understanding the architecture and programming capabilities of ARM microcontroller

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to understand the fundamentals of digital systems. |
| **CO2** | Ability to apply learned fundamental to implement real systems that are useful for the society. |
| **CO3** | Ability to learn the basic concept of synthesis of synchronous as well as asynchronous sequential circuits. |
| **CO4** | Ability to understand and explore the selection criteria of ARM processors by learning the functional level trade off issues. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Number Systems and Codes: Introduction to the positional number system, signed magnitude numbers, floating point numbers, binary arithmetic: addition, subtraction, multiplication and division, Base conversion, conversion formulas with examples, one's and two's compliment arithmetic, Computer codes – BCD codes, gray codes, excess-3 codes, parity checks, Hamming and alphanumeric codes. | **12** |
| **UNIT 2** | Combinational Logic Design: Introduction, standard representations for logical functions, Karnaugh map representation, simplification of logical functions using K-map, minimization of logical functions specified in minterms/maxterms or Truth Table, minimization of logical functions not specified in minterms/maxterms, Don't care conditions, design examples, Ex-or and Ex-nor simplification of K-maps, five and six-variable K-maps, QM method, MEV method, Introduction of multiplexers and their use in combinational logic design, demultiplexers /decoders and their use in combinational logic design, adders and their use as subtractors, digital comparators, parity generators/checkers, code converters, priority encoders, 7-segment decoder/driver. | **12** |
| **UNIT 3** | Synchronous Sequential Circuits and Asynchronous Sequential Circuits: Introduction, FSM model, memory elements and their excitation functions. Synthesis of synchronous sequential circuits, capabilities and limitation of FSM, state equivalence and minimization, simplification of incompletely specified machines, Fundamental mode circuits synthesis, state assignment, pulse mode circuits. | **10** |
| **UNIT 4** | ARM Microcontrollers: Introduction to the architecture, operation modes and states, registers, special registers, floating point registers, general information about Cortex-M3 and cortex M4 processors. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | R.P. Jain: Modern Digital Electronics, TMH Publications. | 2009 |
| 2 | Z Kohavi: Switching and Finite Automata Theory, TMH Publications. | 2009 |
| 3 | M.M. Mano: Digital Logic Design, PHI Publications. | 2004 |
| 4 | Dr. B.R. Gupta: Digital Electronics, Katson Publications. | 2012 |
| 5 | James W. Bignell& Robert Donovan: Digital Electronics, Cengage Learning Publications. | 2013 |
| 6 | Sanjay Kumar Bose: Digital Systems, New Age International Publishers | 2019 |
| 7 | ARM System Developer's Guide Designing and Optimizing System Software by Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier Publications. | 2004 |
| 8 | The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by Joseph Yiu, Elsevier Publications, 3rd Ed., | 2013 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Structures** | **L** | **T** | **P** | **Fundamentals of Programming** |
| | **3** | **0** | **2** | |

**Course Objective:**1) Design correct programs to solve problems.
2) Choose efficient data structures and apply them to solve problems.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to select the data structures that efficiently model the information in a problem. |
| **CO2** | Ability to assess efficiency trade-offs among different data structure implementations or combinations. |
| **CO3** | Implement and know the application of algorithms for sorting and pattern matching. |
| **CO4** | Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to abstract data types, design, implementation and applications. Introduction to List data structure.<br>Arrays and Strings: Representation of Arrays in Memory: one dimensional, Two dimensional and Multidimensional, Accessing of elements of array, performing operations like Insertion, Deletion and Searching. Sorting elements of arrays. Strings and String Operations.<br>Stacks and Queues: Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks , Applications of Stacks : recursion, Polish expression and their compilation conversion of infix expression to prefix and postfix expression, Operations of Queues, Representations of Queues Applications of Queues, Priority queues. | **10** |
| **UNIT 2** | Linked Lists: Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list<br>and Doubly linked list and their Applications. Stacks and Queues as linked list. | **7** |

| | | |
|---|---|---|
| **UNIT 3** | Trees: Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching , Insertion and Deletion , Applications of Binary search Trees , Complete Binary trees, Extended binary trees. General trees, AVL trees, Threaded trees, B- trees. | **9** |
| **UNIT 4** | Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs and their Transversal, Spanning trees, shortest path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths, Strongly connected components, Bipartite Graphs. | **8** |
| **UNIT 5** | File Structure: File Organization, Indexing & Hashing, Hash Functions, Collision Resolution Techniques. Searching and Sorting: Linear Search, Binary search, Interpolation Search,Insertion Sort, Quick sort, Merge sort, Heap sort, sorting on different keys, External sorting. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Horowitz and Sahni, “Fundamentals of Data structures”, Galgotia publications. | 1999 |
| **2** | Tannenbaum, “Data Structures”, PHI. | 2007 |
| **3** | An introduction to data structures and application by Jean Paul Tremblay & Pal G. Sorenson (McGraw Hill). | 2017 |
| 4 | Data Structures and Algorithms Made Easy by Narasimha Karumanchi, CareerMonk Publications | 2016 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Science and Visualization** | **L** | **T** | **P** | Probability, Statistics, Linear Algebra |
| | **3** | **0** | **2** | |

**Course Objective:** 1. To familiarize with different types of data and its visualization.
2.To understand and practice data pre-processing and data exploration.
3. To solve real-world analytical problems in data science.

| **S. NO.** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Ability to identify different types of data and data distributions. |
| **CO2** | Ability to understand and apply different data cleaning and data transformation techniques. |
| **CO3** | Ability to understand and implement different data visualization techniques. |
| **CO4** | Ability to understand and execute different data exploration techniques. |
| **CO5** | Ability to implement different real-world applications of data science. |

| **S. NO.** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to data science: Basics of Probability & Statistics (Random Variables, Bayes’s Theorem, Normal distribution, Central Limit Theorem). Defining data science, Recognizing different types of data, Data distributions. Data acquisition and data storage. | **10** |

| | | |
|---|---|---|
| **UNIT 2** | Data pre-processing: Missing data problem, Outlier definition. Data cleaning, Data transformation or data wrangling procedures such as merging, ordering and aggregating. | **10** |
| **UNIT 3** | Data visualization: Introduction to data visualization. Definition of Dashboard, Dashboard design and principles. Basic charts and plots, Box plots, Histogram, Graphs, Networks, Hierarchies, Reports. | **10** |
| **UNIT 4** | Exploratory Data Analysis: Data exploration for univariate data. Outlier detection techniques. Descriptive statistics (mean, standard deviation etc.) for data exploration. Correlation statistics for data exploration. Data exploration for multivariate data. Use of multivariate visualization tools such as bar charts, bar plots, heat maps, bubble charts, run charts, and scatter plots. | **12** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Data science from scratch, Joel Grus, 2nd ed., O'Reilly Media. | 2019 |
| **2** | Doing data science: Straight talk from the frontline, Cathy O'Neil, Rachel Scutt, O'Reilly Media. | 2013 |
| **3** | Python data science handbook, Jake VanderPlas, 2nd ed., O'Reilly Media. | 2016 |
| **4** | Introducing data science, Davy Cielen, Arno D.B. Meysman, Mohamed Ali, 1st ed., Manning publications. | 2016 |
| **5** | The data science handbook, Field Cady, John Wiley & sons. | 2017 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Communications** | **L** | **T** | **P** | Mathematics, Physics |
| | **3** | **1** | **0** | |

**Course Objective**: 1. To understand various key components for data communication systems.
2.To familiarize with the mathematical and physical principles of digital transmission techniques.
3. To understand and differentiate among various data communication techniques and devices.

| **S. NO.** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts and application of data communications |
| **CO2** | Develop a comprehensive understanding of fundamental data communication concepts, digital transmission techniques,data representation, synchronization and multiplexing. |
| **CO3** | Acquaint the principles of modulation process for different digital modulation systems. |
| **CO4** | Learn to evaluate working of waveform coding techniques and analyse their performance |
| **CO5** | Develop the understanding of design issues of digital communication channels, switching systems and devices |

| **S. NO.** | **Contents** | **Contact Hours** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | Introduction to Data Communication: Definition, Characteristics & Components of Data Communication System. Data Representation, types of Communication and data transmission modes. Synchronous and Asynchronous Transmission. Communication model, Sender, Receiver, Carrier and data flow. | **10** |
| **UNIT 2** | Data and signals : Analog and Digital data & signals. Periodic and nonperiodic signals. Phase, wavelength, time and frequency domains.Concept of bandwidth. Bit rate, bit length, transmission of digital signals. Impairments, attenuation, distortion, noise. Data rate limits, bandwidth, throughput, latency (delay), bandwidth-delay product & jitter. | **10** |
| **UNIT 3** | Digital Transmission: Analog to digital and digital to digital conversion .Line Coding, Line Coding Schemes, Block Coding, Scrambling. Digital Modulataion techniques , Pulse Code Modulation (PCM) and Delta Modulation (DM). Parallel and Serial Transmission, Bandwidth Utilization-Multiplexing and Spreading: | **10** |
| **UNIT 4** | Transmission media & Physical layer: Guided media: twisted-pair cable, coaxial cable, fiber-optic cable. Unguided media-wireless: radio waves, microwaves infrared. Performance comparison of Wired and Wireless Media. Physical Layer Specifications, Signaling, and network devices at Physical Layer | **8** |
| **UNIT 5** | Introduction of Switching Networks: Switching Methods and devices, access points, hubs , routers , gateways. Comparison of, Circuit, Packet Switching datagram and Virtual circuit switching . Structure of Switch. | **4** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Data Communications and Networking , 6th Edition by Behrouz A. Forouzan ,Tata McGraw-Hill | 2022 |
| **2** | Data and Computer Communications, 10th Edition by Stallings William, Pearson Higher Ed Publication | 2017 |
| **3** | Computer Networks 6th Edition by Andrew S. Tanenbaum, Pearson Higher Ed Publication | 2022 |
| **4** | Communication Systems, Fourth Edition, Simon Haykin, — John Wiley & Sons. | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Principles of Computing** | **L** | **T** | **P** | Elementary set theory, Relations, Mappings, and linear algebra |
| | **3** | **1** | **0** | |

**Course Objective:** To provide knowledge and skills in theoretical foundations of computing that are needed to study and practice computer science.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Ability to understand the basic scientific principles of computing. |
| **CO2** | Ability to analyze, evaluate and conduct membership tests for grammars belonging to different formal languages. |
| **CO3** | Ability to design automata for a given language. |

| | |
|---|---|
| **CO4** | Ability to construct accepting and computing Turing Machines for a given language. |
| **CO5** | Ability to understand, analyze and evaluate complexity, reducibility, decidability, undecidability. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Computing: The scientific foundations of computing, Proof techniques and fundamentals, Concepts of soundness and completeness. | **8** |
| **UNIT 2** | Formal languages: Chomsky heirarchy of grammars, Regular grammars and languages, Context-free grammars and languages, Context-sensitive grammars and languages, Pumping lemma, Closure properties. | **8** |
| **UNIT 3** | Automata theory: Finite automata (NFA and DFA), Push-Down automata, Linear Bounded Automata, Equivalance of automata. | **8** |
| **UNIT 4** | Turing machines: Church Turing Thesis, Computing and accepting Turing Machines, Turing Machine Construction, Variants of Turing Machine, Recursive and recursively enumerable languages, Decidability and Undecidability, Universal Turing Machine, Halting problem. | **10** |
| **UNIT 5** | Computational complexity: Time complexity, Measuring complexity, P and NP classes, Co-NP and NP-Completeness, Problem reduction, Polynomial hierarchy and Hierarchy theorem, Space complexity and Savich's theorem, Log-space reducibility. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Hopcroft, Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education. ISBN-13: 978-0321455369 | 2006 |
| **2** | K.L.P. Mishra and N.Chandrasekaran, “Theory of Computer Science Automata, Languages and Computation”, PHI, ISBN-10: 8120329686 | 2007 |
| **3** | Grimaldi, Ralph P., "Discrete and Combinatorial Mathematics" Pearson Education. | 2006 |
| **4** | Papadimitrou, C. and Lewis, C.L., “Elements of the Theory of Computation”, PHI, ISBN-13:978-0132624787 | 1998 |
| **5** | Sipser, Michael, Ïntroduction to the theory of computation", 3rd ed., Cengage publishers | 2014 |

# FOURTH SEMESTER

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Software Engineering** | **L** | **T** | **P** | Programming Fundamentals |
| | **3** | **0** | **2** | |

**Course Objective:** 1. This course focuses on engineering practices and processes that development team uses to make sure the team is setup for change.
2. The course introduces practices, techniques and processes that can help team build high quality software.

| S. NO. | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand the fundamental concepts and need of software engineering |
| **CO2** | Develop a comprehensive understanding of principles, patterns, architecture and software components. |

| | |
|---|---|
| **CO3** | Apply principles and algorithms to understand Agile software development model. |
| **CO4** | Learn to critically evaluate the various tecsting techniques and test case generations. |
| **CO5** | Comfortably and effectively participate in various techniques and processes for building scalable and high quality software. |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction of Software Engineering: Need for software engineering, Software quality attributes, Software product pipelines, Software life cycle models and processes, Requirement engineering using UML Diagrams. | **9** |
| **UNIT 2** | Software Architecture and Design: Design principles, Design Patterns, Architecture Versus Design, Modularity,Software Components and Connectors, Architecture Styles. | **6** |
| **UNIT 3** | Essence of Modern Software Engineering: Software engineering essence, Essence language, Essence kernel, Using essence kernel in agile development practices, Agile Principles, Agile process models through essence kernel, Large scale complex development Using kernel | **13** |
| **UNIT 4** | Software Testing: Quality metrics, Coding style and Static analysis tools, Verification and validation ,Various testing techniques and Test case generations. | **7** |
| **UNIT 5** | Software Project Management: Software versioning and Continuous integration, Project management and Risk analysis, Configuration management, Cost analysis and estimation. | **7** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | R.S. PRESSMAN, B.R. MAXIM (2019), Software Engineering: A Practitioner's Approach, McGraw-Hill India, 2019, 9th Edition. | 2019 |
| **2** | Mark Richards, Neal Ford (2020), Fundamentals of Software Architecture, O'Reilly Media, Inc. | 2020 |
| **3** | L. BASS, P. CLEMENTS, R. KAZMAN (2012), Software Architecture in Practice, Pearson, 3rd Edition. | 2012 |
| **4** | I. JACOBSON, H. LAWSON, P.W. NG, P.E. McMAHON, M. GOEDICKE (2019), The Essentials of Modern Software Engineering, ACM Books. | 2019 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **ALGORITHM DESIGN AND ANALYSIS** | **Course Structure** | | | **Pre-Requisite** |
| | **L** | **T** | **P** | **Data Structures** |
| | **3** | **1** | **0** | |

**Course Objective:** To introduce the concept of algorithmic efficiency by analyzing various algorithms such as Searching, Sorting, Divide-and-Conquer algorithms and to know about Dynamic Programming techniques, Greedy Paradigm, Back Tracking, Branch and Bound, and Computational Complexity.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Abilty to analyse and compare the runtime complexities of algorithms using various techniques. |

| | |
|---|---|
| **CO2** | Abilty to classify and solve problems using Divide and Conquer technique |
| **CO3** | Abilty to classify and solve problems using Dynamic Programming Techniques |
| **CO4** | Abilty to classify and solve problems using Greedy Paradigm |
| **CO5** | Abilty to identify and solve problems using Back-Tracking and Branch and Bound techniques |
| **CO6** | Abilty to learn NP-complete and NP-hard problems, and design approximate Solutions. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction: Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem, Substitution method and Recursion Tree method. | **6** |
| **UNIT 2** | Divide and Conquer: Structure of divide-and-conquer algorithms; examples: binary search, quick sort, Strassen Matrix Multiplication; merge sort, heap sort and Analysis of divide and conquer run time recurrence relations. | **7** |
| **UNIT 3** | Dynamic programming: Principles of dynamic programming. Applications: Rod cutting problem, Matrix Chain multiplication, Longest Common subsequence, Travelling salesman Problem, and Floyd-Warshall algorithm for all pair shortest paths. | **8** |
| **UNIT 4** | Greedy Method: Overview of the greedy paradigm examples of exact optimization solution: Activity Selection Problem., minimum cost spanning tree, approximate solutions: Knapsack problem, Kruskal's algorithm and Prim's algorithm for finding Minimum cost Spanning Trees, Dijkstra's, and Bellman Ford Algorithm for finding Single source shortest paths, Huffman coding. | **8** |
| **UNIT 5** | Back tracking: Overview, 8-queen problem, and Knapsack problem, Traveling Salesman problem.<br>Branch and bound: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem. | **7** |
| **UNIT 6** | Computational Complexity: Complexity measures, Polynomial Vs non-polynomial time complexity; NP-hard and NP-complete classes, examples: Circuit Satisfiability, Vertex cover, Subset Sum problem, Randomized Algorithms, String Matching, NP-Hard and NP-Completeness, Approximation Algorithms, Sorting Network, Matrix Operations, Polynomials and FFT, Number Theoretic Algorithms. | **6** |
| | **TOTAL** | **42** |

**REFERENCES**


| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
|---|---|---|
| **1** | T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd Ed., PHI. | 2011(Reprint) |
| **2** | E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication | 2010 (RePrint) |
| **3** | Sara Basse, A. V. Gelder, "Computer Algorithms: : Introduction to Design and Analysis" Addison Wesley, 3rd Edition, Pearson Education India | 2002 |
| **4** | Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman "Design & Analysis of Computer Algorithms", 1e Paperback – 1 January 2002, Pearson Education India | 2002/eighth impression |


| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Operating Systems** | **L** | **T** | **P** | **C Programming and Data** |

| Operating Systems | 3 | 0 | 2 | Structures |
|---|---|---|---|---|

**Course Objective:** 1. To provide an understanding of the fundamental concepts of operating systems.
2. To provide insight into the functional modules of operating systems.
3. To study the concepts underlying the design and implementation of operating systems.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Abilty to understand the basic concepts and functions of operating systems. |
| **CO2** | Abilty to understand Processes, Threads, and Deadlocks |
| **CO3** | Abilty to analyze Scheduling algorithms |
| **CO4** | Abilty to analyze memory management schemes. |
| **CO5** | Abilty to understand I/O management and File systems. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection.<br>Operating System Structure: System Components, System structure, Operating System Services | **6** |
| **UNIT 2** | Concurrent Processes: Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication,<br>Process Generation, Process Scheduling.<br>CPU Scheduling: Scheduling Concept, Performance Criteria of Scheduling Algorithm, Evolution, Multiprocessor Scheduling. | **10** |
| **UNIT 3** | Deadlock: System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock combined approach. | **8** |
| **UNIT 4** | Memory Management: Base machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replacement algorithms, Allocation of frames, Thrashing, Cache memory organization, Impact on performance. | **10** |
| **UNIT 5** | I/O Management & Disk Scheduling: I/O devices and organization of I/O function, I/O Buffering, DISK I/O, Operating System Design Issues.<br>File System: File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Silberschatz, A, Galvin, P.B., Gagne G., “Operating System Concepts” 10th edition, Wiley Publishers. | 2018 |
| **2** | Stallings W, “Operating Systems “, 9th edition, Pearson Education | 2018 |
| **3** | Maurice Bach, "Design of Unix Operating System", PHI. | 2013 |

| B.Tech. Information Technology | | |
|---|---|---|
| **Course code: Course Title** | **Course Structure** | **Pre-Requisite** |

| Database Management Systems | L | T | P | Data structures |
|---|---|---|---|---|
| | 3 | 0 | 2 | |

**Course Objective:** 1. To understand the concepts of database management system and its applications, data modeling, database design, and query languages.
2. To understand different files structures, transaction management, concurrency control, database recovery, query processing and optimization

| S. NO | Course Outcomes (CO) |
|---|---|
| CO1 | Ability to apply different data modeling methods in requirement analysis, design, and implementation of database system. |
| CO2 | Ability to apply the normal forms for efficient designing of relational database. |
| CO3 | Ability to use appropriate storage and access structures . |
| CO4 | Ability to use techniques for transaction management, concurrency control, and recovery. |
| CO5 | Ability to analyze complexity issues of query execution |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | Introduction: Database system concepts and its architecture, Data models schema and instances, Data independence and database language and interface, Data definition languages, DML. Overall database structure.Data modeling using Entity Relationship Model: E.R. model concept, notation for ER diagrams mapping constraints, Keys, concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model. | 9 |
| UNIT 2 | Relational Data Model and Language: Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL. | 9 |
| UNIT 3 | Data Base Design: Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal form, join dependencies and fifth normal form. Inclusion dependencies, lossless join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design | 8 |
| UNIT 4 | File Organization, Indexing and Hashing Overview of file organization techniques, Indexing and Hashing- Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management Transaction processing concepts: Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling. | 8 |
| UNIT 5 | Concurrency Control Techniques: Locking Techniques for concurrency control, time stamping protocols for concurrency control, concurrency control in distributed systems. multiple granularities and multi-version schemes. | 8 |
| | TOTAL | 42 |

| REFERENCES | | |
|---|---|---|
| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
| 1 | Elmasri, Navathe,"Fundamentals of Database systems", Addision Wesley | 2019 |

| | | |
|---|---|---|
| **2** | Korth, Silbertz, Sudarshan,"Data base concepts", McGraw-Hill. | 2021 |
| **3** | Ramakrishna, Gehkre, "Database Management System", McGraw-Hill | 2002 |
| **4** | Date C.J.,"An Introduction to Database systems" | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Machine Learning** | **L** | **T** | **P** | Probability, Statistics and Stochastic Processes, Linear Algebra |
| | **3** | **0** | **2** | |

**Course Objective**: 1. To understand various key paradigms for machine learning approaches.
2.To familiarize with the mathematical and statistical techniques used in machine learning.
3. To understand and differentiate among various machine learning techniques.

| **S. NO.** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts and algorithms of machine learning |
| **CO2** | Develop a comprehensive understanding of fundamental machine learning concepts, algorithms, and techniques, including supervised and unsupervised learning, classification, regression, clustering, and dimensionality reduction. |
| **CO3** | Apply principles and algorithms to evaluate models generated from data |
| **CO4** | Learn to critically evaluate the performance of machine learning models using appropriate metrics |
| **CO5** | Develop the ability to identify and formulate problems suitable for machine learning solutions, design appropriate models, and interpret results in practical applications. |

| **S. NO.** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to Machine Learning: Overview of different tasks: classification, regression, clustering, Concept of learning, Types of the Machine Learning, Data Table, Information System, Data Representation, diversity of data, Basic Linear Algebra and Probaboliy Theory, Optimization: Maximum likelihood, Expectation maximization, Gradient descent, Bias-Variance Tradeoff, Metrics to Evaluate Classification and Regression models | **14** |
| **UNIT 2** | Supervised Learning: Linear Regression, Logistic Regression, Baysian Decision Theory, Naïve Bayes, K-Nearest Neighbour, Support Vector Machine, Decision trees, Ensemble Classifier, Random Forest, Linear Classifiers and Kernels, Neural Networks, Deep Neural Network, Fundametals of Deep Learning: DNN, CNN. | **14** |
| **UNIT 3** | Unsupervised Learning: Clustering, Expectation Maximization, K-Mean Clustering, Hierarchical vs Partitional Clustering, Gaussian Mixture Model, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning. | **14** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Introduction to Machine Learning, Alpaydin, E.,PHI Learning Pvt. Ltd. | 2015 |
| **2** | Machine Learning, Tom Mitchell, McGraw Hill | 2017 |
| **3** | Applied Machine Learning by M.Gopal\|, McGraw Hill, ISBN: 978-9354601590 | 2021 |

| | | |
|---|---|---|
| **4** | Understanding Machine Learning: From Theory to Algorithms, 1st Edition,by Shai Shalev-Shwartz, Cambridge University Press | 2015 |
| **5** | Pattern Recognition and Machine Learning by Christopher Bishop, Springer Verlag | 2006 |
| **6** | Pattern Classification by Richard Duda, Wiley Publisher | 2007 |

# FIFTH SEMESTER

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Compiler Design** | **L** | **T** | **P** | Principles of computing |
| | **3** | **0** | **2** | |

**Course Objective:** 1. To familiarize with the basic concepts of compiler design such as parsing and code optimization.
2.To design and implement different phases of a compiler.
3. To execute IR and target code generation and optimization.

| S. NO. | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to understand and describe the phases of a compiler |
| **CO2** | Ability to design and implement lexical analyzer |
| **CO3** | Ability to design and implement top-down or LL parsers |
| **CO4** | Ability to design and implement bottom-up or LR parsers |
| **CO5** | Ability to translate various expressions and statements. |
| **CO6** | Ability to execute IR and target code generation and optimization |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction:** Compiler flowchart - Phases of a compiler. Data Structure for Symbol Tables, representing scope information. Run time allocation: Stack versus Heap management. | **6** |
| **UNIT 2** | **Lexical analysis**: Input buffers and sentinels, Tokens and lexemes, Lexical categories, Implementation of Lexical Analyzer for an input string using regular expressions and NFA, Thompson algorithm, Subset construction, Automatic Lexical Analyzer Generator - Lex. | **8** |
| **UNIT 3** | **Syntax analysis**: Formal Grammars and their application to Syntax Analysis, BNF Notation, Derivation and Parse Trees, Top down parsing- elimination of left recursion, left factoring, recursive descent parsers, predictive parsers or LL(k) parsers. Bottom up parsing- LR Parsers, the canonical collection of LR(0) items, constructing SLR Parsing Tables, canonical LR Parsing tables and LALR parsing tables, An Automatic Parser Generator - YACC. Error detection and error recovery schemes. | **10** |

| | | |
|---|---|---|
| **UNIT 4** | **Syntax Directed Translation**: Syntax Directed Definition (SDD), L-attributed and S-attributed SDD, Parse Trees, Annotated parse tree and Abstract Syntax Tree (AST), Syntax directed Translation Schemes, Postfix notation, Desktop calculator, Semantic analysis, Translation of Assignment Statements, Boolean expressions, Control Statements, Array references , Procedure Calls, Declarations and Case statements. | **8** |
| **UNIT 5** | **Code generation and optimization**: Three address code or IR code, Storage structures for IR code: Quadruple, Triple and Indirect Triple. Syntax directed translation for IR code generation. IR code optimization using Directed Acyclic Graph (DAG), Loop optimization, Global data flow analysis. Target code generation and optimization. | **10** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Aho, Lam, Sethi and Ullman, “Compilers: Principles, Techniques and Tools”, Second edition, Pearson Education. | 2013 |
| **2** | D.M.Dhamdhere, “Compiler Construction – Principles & Practice”, Macmillan India. | 2000 |
| **3** | A. Appel, "Applied Intelligence for Medical Image Analysis", Cambridge university press. | 2004 |
| **4** | K.C. Loude, "Compiler construction: Principles and Practice", Course Technology Inc | 1997 |
| **5** | K.D. Cooper and L. Torczon, "Engineering a compiler", 3rd ed., Morgan Kaufmann. | 2023 |

**B.Tech. Information Technology**

| Course code: Course Title | Course Structure | | | Pre-Requisite |
|---|---|---|---|---|
| **Computer Networks** | **L** | **T** | **P** | Operating systems, Algorithm Design and Analysis |
| | **3** | **2** | **0** | |

**Course Objective:** To understand design and application of layered architechture and protocols of computer networks

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand basic concepts, OSI reference model, services and role of each layer of OSI model and |
| **CO2** | Apply channel allocation, framing, error and flow control techniques. |
| **CO3** | Functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism |

| | |
|---|---|
| **CO4** | Transport & Application Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introductory Concepts: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. Physical Layer | **8** |
| **UNIT 2** | Link layer: Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges | **8** |
| **UNIT 3** | Network Layer: Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6. | **9** |
| **UNIT 4** | Transport Layer: Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service. | **9** |
| **UNIT 5** | Application Layer: Domain Name System, World Wide Web and Hyper Text Transfer Protocol,<br>Electronic mail, File Transfer Protocol, Remote login, Network management | **8** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Behrouz Forouzan, “Data Communication and Networking”, McGraw Hill | 2021 |
| **2** | Andrew Tanenbaum “Computer Networks”, Prentice Hall. | 2018 |
| **3** | William Stallings, “Data and Computer Communication”, Pearson. | 2004 |
| **4** | Kurose and Ross, “Computer Networking- A Top-Down Approach”, Pearson. | 2012 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Computer Organization and Architecture** | **L** | **T** | **P** | Digital Electronics & Microcontrollers |
| | **3** | **1** | **-** | |

**Course Objective:** To learn and understand the organisatuion and architecture of computer system.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Explain the working of computer systems & its basic principles |
| **CO2** | Design the basic structure of processor and control design |
| **CO3** | Discuss the basic concepts of pipelining techniques |
| **CO4** | Highlights the memory hierarchy and its organization and working of I/O devices with its interfacing |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to digital electronics: combinational circuits and sequential circuits. Basic machine Principle, Structure and representation of real world data. Subroutine, Branching & Macro facility | **6** |
| **UNIT 2** | Processor Organization, Information representation and Number format, Instruction cycle and Instruction format, Addressing modes, Arithmetic operation, timed point addition, subtraction, multiplication and division, ALU design, Parallel processing – Performance consideration, Pipeline processor | **9** |
| **UNIT 3** | Instruction sequencing and Interpretation, Hardware Control design method and Microprogrammed Control | **9** |
| **UNIT 4** | Memory device characteristic, Random access and serial access memories, Virtual memory – memory hierarchies, Page replacement policies, Segments, pages and file organization, High speed memories – cache and associative memory | **9** |
| **UNIT 5** | Memory device characteristic, Random access and serial access memories, Virtual memory – memory hierarchies, Page replacement policies, Segments, pages and file organization, High speed memories – cache and associative memory | **9** |
| | **TOTAL** | **42** |

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | M.M. Mano: Computer System Architecture, 3rd Ed. PHI. | 2017 |

| | | |
|---|---|---|
| **2** | J.P. Hayes: Computer Architecture and Organization, 3rd Ed. TMH | 2017 |
| **3** | C.W. Gear: Computer organization and Programming, TMH. | 1980 |
| **4** | T.C. Bartee: Digital Computer Fundamental, TMH. | 2001 |
| **5** | A. S. Tanenbaum: Structured Computer System Organization, PHI. | 2016 |

## DEPARTMENT ELECTIVE COURSE-1

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Deep Learning** | **L** | **T** | **P** | Machine Learning |
| | **3** | **0** | **2** | |

**Course Objective:**The primary objective of a deep learning course for undergraduate students is to equip them with a solid foundation in the theory and practical application of deep learning techniques**.**

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Demonstrate a clear understanding of the fundamental concepts of deep learning, including neural networks, activation functions, loss functions, and optimization techniques. |
| **CO2** | Design, implement, and train basic neural network architectures, including feedforward networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) using modern deep learning frameworks like TensorFlow or PyTorch. |
| **CO3** | Apply deep learning techniques to solve complex problems in various domains such as image classification, object detection, natural language processing, and time-series prediction. |
| **CO4** | Explore and implement advanced deep learning techniques such as transfer learning, generative adversarial networks (GANs), attention mechanisms, and transformers to address cutting-edge research and industry challenges. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Overview of Artificial Intelligence, Machine Learning, and Deep Learning, History and evolution of deep learning, Applications of deep learning, Perceptron and multi-layer perceptron, Activation functions, Loss functions and their significance, Gradient Descent and Backpropagation, Neural Networks: Deep vs Shallow Networks, Training Deep Networks: Vanishing and Exploding Gradients, Techniques to mitigate gradient issues (Batch Normalization, Gradient Clipping), Optimization algorithms (SGD, Adam, RMSprop), Regularization techniques (L2, Dropout), and Weight Initialization | **16** |

| | | |
|---|---|---|
| **UNIT 2** | Convolutional Neural Networks, and their significance in image processing, Convolution operations and feature maps. Pooling layers, CNN architectures: LeNet, AlexNet, VGG, ResNet, Inception, Transfer learning and fine-tuning pre-trained models, Object detection and segmentation (YOLO, SSD, Mask R-CNN), Introduction to Generative Adversarial Networks, Autoencoder. Variational Autoencoders. | **14** |
| **UNIT 3** | Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, Gated Recurrent Unit (GRU), Attention Mechanisms and Transformers, Sequence-to-sequence models with attention, and applications in natural language processing. | **12** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Deep Learning by Ian Goodfellow , Yoshua Bengio , and Aaron Courville, MIT Press (https://www.deeplearningbook.org/) | 2016 |
| **2** | Deep Learning: Foundations and Concepts by Christopher M. Bishop and Hugh Bishop, Springer | 2023 |
| **3** | Introduction to Deep Learning by Eugene Charniak, MIT Press | 2019 |
| 4 | Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron | 2022 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Cyber Laws** | **L** | **T** | **P** | |
| | **3** | **2** | **0** | |

**Course Objective:** The purpose is to understand the basics of cyber security, laws, and related issues.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To explain the information on cyber security and understand the issues that are specific to amendment rights. |
| **CO2** | Examine the risks and legal implications of copyright issues, internet infringement, privacy rights, and related constitutional and federal statutes. |
| **CO3** | Understand duty of care, criminal liability, procedural issues, and the legal framework surrounding electronic contracts, digital signatures, and civil rights. |
| **CO4** | Assess the ethical implications and societal impacts of cyber security, with a focus on legal developments, case studies, and the evolution of cyber law from the late 1990s to 2000. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | The World Wide Web, Web Centric Business, E Business Architecture, Models of E Business, E Commerce, Threats to virtual world. Cyber Crimes& social media, Cyber Squatting, Cyber Espionage, Cyber Warfare, Cyber Terrorism | **7** |
| **UNIT 2** | Computer ethics, moral and legal issues, descriptive and normative claims, Professional Ethics, code of ethics and professional conduct. Privacy, Computers and privacy issue. | **8** |
| **UNIT 3** | Web Servers and Browsers, HTTP, Cookies, Caching, Plug-in, ActiveX, Java, JavaScript, Secure Socket Layer (SSL), Secure Electronic Transaction (SET). E-mail Risks, Spam, E-mail Protocols, Simple Mail Transfer Protocol (SMTP), Post office Protocol (POP), Internet Access Message protocol (ICMP). Secured Mail Protocols | **10** |
| **UNIT 4** | Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Domain name registration, Software Piracy, Legal Issues in Cyber Contracts, Authorship, Document Forgery. | **8** |
| **UNIT 5** | Indian IT ACT, Adjudication under Indian IT ACT, IT Service Management Concept, IT Audit standards, System audit, Information security audit, ISMS, SoA (Statement of Applicability), BCP (Business Continuity Plan), DR (Disaster Recovery), RA (Risk Analysis/Assessment). | **9** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Jonathan Rosenoer. "Cyber Law: The law of the Internet", Springer-Verlag. | 1997 |
| **2** | Mark F Grady. FransescoParisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006 | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Malware Analysis** | **L** | **T** | **P** | **-** |
| | **3** | **1** | **0** | |

**Course Objective:** To introduce fundamentals of malware and to set up a protected static and dynamic malware analysis environment. Learn various malware behavior monitoring tools and actionable detection signatures from malware indicators. Learn how to trick malware into exhibiting behaviors that only occur under special conditions.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | To list the goals of Malware Analysis and to define Malware Analysis techniques. |
| **CO2** | To employ and illustrate static malware analysis techniques. |
| **CO3** | To employ and illustrate dynamic malware analysis techniques. |
| **CO4** | To classify and describe malware functionalities and behaviors |
| **CO5** | To be able to examine malwares with reverse engineering. |
| **CO6** | To be able to examine malwares with reverse engineering. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types viruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. | **6** |
| **UNIT 2** | X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, Reverse Engineering- x86 Architecture, recognizing c code constructs in assembly, c++ analysis, Analysing Windows programs, Anti-static analysis techniques-obfuscation, packing, metamorphism, and polymorphism. | **8** |
| **UNIT 3** | Live malware analysis, dead malware analysis, analyzing traces of malware-system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques-anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wire shark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching | **7** |
| **UNIT 4** | Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection. | **8** |

| | | |
|---|---|---|
| **UNIT 5** | Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences | **7** |
| **UNIT 6** | Malware Characterization, Case Studies – Plankton, DroidKungFu, AnserverBot, Smartphone (Apps) Security | **6** |
| | **Total** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Practical malware analysis The Hands-On Guide to Dissecting Malicious Software by Michael Sikorski and Andrew Honig ISBN-10: 1-59327-290-1, ISBN-13: 978-1-59327-290-6 | 2012 |
| **2** | Android Malware by Xuxian Jiang and Yajin Zhou, Springer ISBN 978-1-4614-7393-0 | 2005 |
| **3** | Hacking exposed™ malware & rootkits: malware & rootkits security secrets & Solutions by Michael Davis, Sean Bodmer, Aaron Lemasters, McGraw-Hill, ISBN: 978-0-07-159119-5 | 2010 |
| **4** | Windows Malware Analysis Essentials by Victor Marak, Packt Publishing | 2015 |

**B.Tech. Information Technology**

| Course code: Course Title | Course Structure | | | Pre-Requisite |
|---|---|---|---|---|
| | L | T | P | |
| **Internet of Things** | 3 | - | 2 | **Fundamental of Computer Networks** |

**Course Objective:** (1) To introduce the terminology, technology and its applications (2) To introduce the concept of M2M (machine to machine) with necessary protocols (3) To introduce the Python Scripting Language which is used in many IoT devices
(4) To introduce the Raspberry PI platform, that is widely used in IoT applications
(5) To introduce the implementation of web-based services on IoT devices

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand IoT value chain structure (device, data cloud), application areas and technologies involved. |

| | |
|---|---|
| **CO2** | Explore IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules |
| **CO3** | Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to Internet of Things:** Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry | **9** |
| **UNIT 2** | **IoT and M2M:** Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCONF, YANG- NETCONF, YANG, SNMP NETOPEER | **8** |
| **UNIT 3** | **IoT Physical Devices and Endpoints:** Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C) Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors | **8** |
| **UNIT 4** | **Introduction to Sensors:** Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor | **8** |
| **UNIT 5** | **IoT Physical Servers and Cloud Offerings**: Introduction to Cloud Storage models and communication APIs Web Server – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API | **9** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, ISBN: 9788173719547 | 2015 |
| **2** | Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), ISBN: 9789350239759 | 2014 |
| **3** | Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press | 2021 |
| **4** | Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), ISBN 7989352133895 | 2016 |

| | | |
|---|---|---|
| **5** | Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015, Editors Ovidiu Vermesan | 2015 |
| **6** | Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications | 2013 |
| **7** | Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014 | 2014 |
| **8** | N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014 | 2014 |
| **9** | Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,2012 | 2012 |
| **10** | Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applicationsand Protocols”, Wiley, 2012. | 2012 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Computer Graphics** | **L** | **T** | **P** | **-** |
| | **3** | **-** | **2** | |

**Course Objective:** To provide students with a comprehensive understanding of the fundamental principles and techniques in computer graphics, including graphic systems, transformations, viewing pipelines, clipping algorithms, curve and surface modeling, projection methods, shading models, and hidden surface removal.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Apply various algorithms for line drawing, circle and ellipse generation, filling techniques, and anti-aliasing in computer graphics. |
| **CO2** | Apply 2D and 3D transformations, including matrix representations, composite transformations, and coordinate system conversions in computer graphics. |
| **CO3** | Implement viewing pipelines and apply various clipping algorithms for lines, polygons, and text in a two-dimensional viewing context. |
| **CO4** | Analyze and construct curves and surfaces using parametric equations, Bezier curves, and B-Spline techniques with continuity testing. |
| **CO5** | Understand and apply different projection methods, including parallel, oblique, and perspective projections for 3D objects onto 2D planes. |
| **CO6** | Utilize shading models, reflection calculations, and hidden surface removal techniques to enhance the visual realism of 3D scenes. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | **Overview of Computer Graphics:** Usage of Graphics and their applications, Over view of Graphics systems: Refreshing display devices, Random and raster scan display devices, Colour Models: RGB, HSV etc., Tablets, Joysticks, Track balls, Mouse and light pens. **Output primitives:** DDA Line drawing algorithm, Bresenham's Line Drawing Algorithm, Mid-point circle algorithm, Mid-point Ellipse algorithms, filling algorithms, boundary fill and flood fill algorithms, scanline filling, character generation, line attributes, fill styles, anti-aliasing | **6** |
| **UNIT 2** | **Transformations:** Basic 2D Transformations, Matrix representations & Homogeneous Coordinates, Matrix Representations for basic 2D and 3D transformations, Composite Transformations, reflection and shear transformations, affine transformation, transformations between coordinate systems. | **8** |
| **UNIT 3** | **Two dimensional viewing:** The viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Barky line clipping algorithm, Algorithm for polygon clipping, Sutherland-Hodgeman polygon clipping, Wailer-Atherton polygon clipping, curve clipping, Text clipping. | **6** |
| **UNIT 4** | **Curves and Surfaces:** Representation of surfaces, polygon meshes, plane equations, parametric cubic curves, Hermite Curves, Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, B-Spline Curves, Cubic B-Spline curves using uniform knot vectors, Testing for first and second order continuities. | **8** |
| **UNIT 5** | **Projection:** Parallel Projection, Oblique Projection on XY plane, Isometric Projection, Perspective Projection, One Vanishing Point (V.P.) projection, Generation of 2 V.P. Projection, planar geometric projections. | **7** |
| **UNIT 6** | Shading and Hidden Surface Removal: Shading, Illumination Model for diffused Reflection, Effect of ambient lighting, distances, Specular Reflection Model, Computing Reflection Vector, Curved Surfaces, Polygonal Approximations, Guard Shading, Phong Model, Hidden Surface Removal, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method, Scan Line Method, Depth Sorting Method, Area Subdivision Method. | **7** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | D. Hearn , P. Baker& W. Carithers, "Computer Graphics with OpenGL", Pearson, | 2015 |
| **2** | Z. Xiang & R. Plastock "Computer Graphics", Schaum's Series, McGraw Hill | 2007 |

| | | |
|---|---|---|
| **3** | David F. Rogers, “Procedural Elements for Computer Graphics”, Tata McGraw Hill | 2002 |
| **4** | D. Rogers and J. Adams, “Mathematical Elements for Computer Graphics”, MacGraw- Hill International Edition | 2002 |
| **5** | Foley et al., “Computer Graphics Principles & practice”, Addison Wesley | 1999 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Software Project Management** | **L** | **T** | **P** | **Software Engineering** |
| | **3** | **1** | **-** | |

**Course Objective:** To introduce concepts of software planning, estimation and time scheduling.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts of project management, including process frameworks, software life cycle models, and key artifacts |
| **CO2** | Apply various cost and effort estimation models to accurately estimate project costs and schedules. |
| **CO3** | Implement project management techniques, including risk management, project tracking, and control mechanisms, to ensure successful project execution and delivery. |
| **CO4** | Perform project closure analysis by understanding the role of closure in a project and creating comprehensive closure analysis reports. |
| **CO5** | Analyze the evolution and impact of software economics on conventional and modern software management practices. |
| **CO6** | Discuss future trends in software project management, including next-generation software economics, modern project profiles, and process transitions. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | **Introduction:** Project Management concepts, Process Framework, Project Planning Software Life Cycle Models, Artifacts of the Project Management Process. | **6** |
| **UNIT 2** | **Cost and Scheduling Estimation Models:** Various Levels of COCOMO for Cost ,Effort, Schedule and Productivity Estimation. Approaches to Effort, Cost Estimation, and Schedule Estimation factors through COCOMO II, Putnam Estimation Model, Algorithmic models. | **8** |
| **UNIT 3** | **Project Management Techniques:** Project Organizations and Responsibilities, Establishing Project Environment, Risk Management Process, Project Tracking and Control Defect Tracking Concepts such as Process monitoring and audit, Reviews, Inspections and Walkthroughs. | **8** |

| | | |
|---|---|---|
| **UNIT 4** | **Project Closure:** Project Closure Analysis, Role of Closure Analysis in a project, Performing Closure Analysis, Closure Analysis Report. | **6** |
| **UNIT 5** | **Software Project Management Renaissance:** Conventional Software Management, Evolution of Software Economics, Improving Software Economics, The old way and the new way. | **6** |
| **UNIT 6** | **Advance Topics in Software Project Management:** Discussion on future Software Project Management Practices & Modern Project Profiles, Next Generation Software Economics, Modern Process Transitions. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Managing the Software Process, Watts S. Humphrey, Pearson Education | 1989 |
| **2** | Software Project Management, Bob Hughes, Tata McGraw Hill | 2009 |
| **3** | Sommerville, "Software Engineering", Addison Wesley | 2001 |

## GENERIC ELECTIVE COURSE-1

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Structures and Algorithms** | **L** | **T** | **P** | Programming Fundamentals |
| | **3** | **0** | **2** | |

**Course Objective:** This course introduces fundamental data structures and algorithms, focusing on their design, implementation, and application. Students will learn to optimize time-space complexity while exploring arrays, linked lists, stacks, queues, trees, graphs, sorting, searching, and file structures.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand and apply basic algorithm concepts, including time-space complexity and operations on arrays and strings. |
| **CO2** | Implement and utilize linked lists, including singly, circular, and doubly linked lists, for various applications. |
| **CO3** | Understand and apply tree structures and operations, including binary search trees and AVL trees, to solve computational problems. |
| **CO4** | Implement and analyze various searching and sorting algorithms for efficient data management |
| **CO5** | Understand and implement graph traversal techniques and apply them to real-world problems like shortest paths and network analysis |

| | |
|---|---|
| **CO6** | Apply file organization, indexing, and hashing techniques for efficient data storage and retrieval. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction:** Introduction to Algorithms, Complexity- Time-Space Trade off. Introduction to abstract data types, design, implementation and applications. Introduction to List data structure.<br>**Arrays and Strings:** Representation of Arrays in Memory: one dimensional, Two dimensional and Multidimensional, Accessing of elements of array, performing operations like Insertion, Deletion and Searching. Sorting elements of arrays. Strings and String Operations.<br>**Stacks and Queues:** Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks, Applications of Stacks : recursion, Polish expression and their computation, conversion of infix expression to prefix and postfix expression, Operations of Queues, Representations of Queues Applications of Queues, Priority queues. | **8** |
| **UNIT 2** | **Linked Lists:** Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list and Doubly linked list and their Applications. Stacks and Queues as linked list. | **7** |
| **UNIT 3** | **Trees:** Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching , Insertion and Deletion , Applications of Binary search Trees , Complete Binary trees, Extended binary trees. General trees, AVL trees, Threaded trees, B-trees. | **8** |
| **UNIT 4** | **Searching and Sorting:** Linear Search, Binary search, Interpolation Search,Insertion Sort, Quick sort, Merge sort, Heap sort, sorting on different keys, External sorting. | **8** |
| **UNIT 5** | **Graphs:** Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs and their Transversal, Spanning trees, shortest path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths. | **7** |
| **UNIT 6** | **File Structure:** File Organization, Indexing & Hashing, Hash Functions, Collision Resolution Techniques. | **4** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | "Schaum's Outline of Data Structures with C++" by John R. Hubbard MGH | 2019 |
| **2** | “Fundamentals of Data structures”, Horowitz and Sahni,Galgotia publications | 1983 |
| **3** | "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein MIT | 4th Edition (2022) |
| 4 | “Data Structures”, Tannenbaum, PHI | 2007 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Information and Network Security** | **L** | **T** | **P** | Computer Networks, Operating Systems, Basic Programming |
| | **3** | **1** | **0** | |

**Course Objective:** 1) To provide students with a comprehensive understanding of the principles and practices of information and network security.
2) To equip students with the knowledge and skills to implement cryptographic techniques and network security mechanisms.
3) To introduce students to secure software development practices and application security.
4) To explore advanced topics in security, including incident response, forensics, and emerging security challenges.
5) To prepare students to assess, design, and manage secure information systems and networks.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts of information security, including threat models, security policies, and risk management. |
| **CO2** | Implement cryptographic algorithms and protocols to secure communication and data. |
| **CO3** | Apply network security techniques, including firewalls, intrusion detection, VPNs, and wireless security. |
| **CO4** | Develop secure software applications and mitigate web, mobile, cloud, and database security threats. |
| **CO4** | Engage with advanced security topics, conduct incident response and forensics, and address security challenges in emerging technologies. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | **Introduction to Information Security:**<br>Overview: Definitions, Objectives, and Importance Security Threats and Vulnerabilities: Malware, Phishing, Social Engineering, and Insider Threats.<br>Security Models: CIA Triad (Confidentiality, Integrity, Availability), Bell-LaPadula, and Biba Models<br>Security Policies and Mechanisms: Authentication, Authorization, and Access Control<br>Risk Management: Risk Assessment, Mitigation Strategies, and Security Audits | **10** |
| **UNIT 2** | **Cryptography**<br>Introduction to Cryptography: Definitions and Goals<br>Symmetric Key Cryptography: Algorithms (DES, AES), Modes of Operation, and Key Management<br>Asymmetric Key Cryptography: RSA, ECC, and Digital Signatures<br>Hash Functions: SHA, MD5, and Applications of Hashing<br>Cryptographic Protocols: SSL/TLS, PGP, and Key Exchange Protocols | **12** |
| **UNIT 3** | **Network Security**<br>Overview of Network Security: Goals, Threats, and Attack Vectors<br>Firewalls: Types, Configuration, and Best Practices<br>Intrusion Detection and Prevention Systems (IDPS): Techniques and Tools<br>Virtual Private Networks (VPNs): Architecture, Protocols (IPSec, SSL VPN), and Applications<br>Wireless Network Security: WEP, WPA, WPA2, and Wireless Attack Vectors | **10** |
| **UNIT 4** | **Application and Web Security**<br>Secure Software Development: Secure Coding Practices, OWASP Top 10, and Threat Modeling<br>Web Security: Cross-Site Scripting (XSS), SQL Injection, CSRF, and Secure Session Management<br>Security in Mobile Applications: Common Threats, Security Frameworks, and Best Practices<br>Cloud Security: Threats in Cloud Computing, Security Models, and Cloud Security Standards<br>Database Security: SQL Injection Prevention, Data Encryption, and Access Control | **10** |
| **UNIT 5** | **Advanced Topics in Information and Network Security**<br>Cybersecurity Frameworks and Standards: ISO 27001, NIST, and GDPR Compliance<br>Incident Response and Forensics: Phases of Incident Response, Digital Forensics Tools, and Techniques<br>Security in Emerging Technologies: IoT Security, Blockchain Security, and AI in Security<br>Ethical Hacking and Penetration Testing: Methodologies, Tools, and Legal Aspects<br>Future Trends in Information and Network Security: Quantum Cryptography, Zero Trust Security, and 5G Security | **10** |

| | TOTAL | 42 |
|---|---|---|

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Stallings, W., & Brown, L. Computer Security: Principles and Practice (5th ed.). Pearson. ISBN: 978-0134794105. | 2023 |
| **2** | Schneier, B. Applied Cryptography: Protocols, Algorithms, and Source Code in C (3rd ed.). Wiley. ISBN: 978-1119096726 | 2020 |
| **3** | Kaufman, C., Perlman, R., & Speciner, M. Network Security: Private Communication in a Public World (3rd ed.). Pearson. | 2022 |
| **4** | Anderson, R. Security Engineering: A Guide to Building Dependable Distributed Systems (3rd ed.). Wiley. ISBN: 978-1119642787. | 2021 |
| **5** | Garfinkel, S., & Spafford, G. Practical UNIX and Internet Security (3rd ed.). O'Reilly Media. ISBN: 978-0596003234. | 2022 |

| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
|---|---|---|---|---|
| **Introduction to Computer Networks** | **L** | **T** | **P** | Operating systems, Algorithm Design and Analysis |
| | **3** | **2** | **0** | |

**Course Objective:** To understand design and application of layered architechture and protocols of computer networks.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media. |
| **CO2** | Apply channel allocation, framing, error and flow control techniques. |
| **CO3** | Functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism. |
| **CO4** | Transport & Application Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introductory Concepts: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. Physical Layer | **8** |

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|---|---|---|
| **UNIT 2** | Link layer: Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols).<br>Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges | **8** |
| **UNIT 3** | Network Layer: Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6. | **9** |
| **UNIT 4** | Transport Layer: Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service. | **9** |
| **UNIT 5** | Application Layer: Domain Name System, World Wide Web and Hyper Text Transfer Protocol,<br>Electronic mail, File Transfer Protocol, Remote login, Network management. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Behrouz Forouzan, “Data Communication and Networking”, McGraw Hill | 2021 |
| **2** | Andrew Tanenbaum “Computer Networks”, Prentice Hall. | 2018 |
| **3** | William Stallings, “Data and Computer Communication”, Pearson. | 2004 |
| 4 | Kurose and Ross, “Computer Networking- A Top-Down Approach”, Pearson. | 2012 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Computer Architecture** | **L** | **T** | **P** | Digital Electronics & Microcontrollers |
| | **3** | **1** | **-** | |

**Course Objective:** To learn and understand the organisatuion and architecture of computer system.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Explain the working of computer systems & its basic principles |

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|---|---|
| **CO2** | Design the basic structure of processor and control design |
| **CO3** | Discuss the basic concepts of pipelining techniques |
| **CO4** | Highlights the memory hierarchy and its organization and working of I/O devices with its interfacing |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to digital electronics: combinational circuits and sequential circuits. Basic machine Principle, Structure and representation of real world data. Subroutine, Branching & Macro facility | **6** |
| **UNIT 2** | Processor Organization, Information representation and Number format, Instruction cycle and Instruction format, Addressing modes, Arithmetic operation, timed point addition, subtraction, multiplication and division, ALU design, Parallel processing – Performance consideration, Pipeline processor | **9** |
| **UNIT 3** | Instruction sequencing and Interpretation, Hardware Control design method and Microprogrammed Control | **9** |
| **UNIT 4** | Memory device characteristic, Random access and serial access memories, Virtual memory – memory hierarchies, Page replacement policies, Segments, pages and file organization, High speed memories – cache and associative memory | **9** |
| **UNIT 5** | Memory device characteristic, Random access and serial access memories, Virtual memory – memory hierarchies, Page replacement policies, Segments, pages and file organization, High speed memories – cache and associative memory | **9** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | M.M. Mano: Computer System Architecture, 3rd Ed. PHI. | 2017 |
| **2** | J.P. Hayes: Computer Architecture and Organization, 3rd Ed. TMH | 2017 |
| **3** | C.W. Gear: Computer organization and Programming, TMH. | 1980 |
| **4** | T.C. Bartee: Digital Computer Fundamental, TMH. | 2001 |
| **5** | A. S. Tanenbaum: Structured Computer System Organization, PHI. | 2016 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Introduction to Database Systems** | **L** | **T** | **P** | **-** |
| | **3** | **-** | **2** | |

**Course Objective:**To provide knowledge about the principles, concepts and applications of Database Systems.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand the architecture, data models, and fundamental concepts of database systems, including data independence and database languages and design ER diagrams |
| **CO2** | Apply relational data model principles, including integrity constraints, relational algebra, and SQL, to design and manipulate relational databases. |
| **CO3** | Implement database normalization techniques using functional dependencies and various normal forms to achieve an optimized database design. |
| **CO4** | Analyze and implement various file organization, indexing, and hashing techniques for efficient data retrieval and storage. |
| **CO5** | Understand and manage transaction processing, including serializability, recoverability, and handling of transaction failures and deadlocks. |
| **CO6** | Apply concurrency control mechanisms, including locking techniques and time-stamping protocols, to ensure consistency in distributed database systems. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction**: Data base system concepts and its architecture, Data models schema and instances, Data independence and data base language and interface, Data definition languages, DML. Overall database structure. **Data modeling using Entity Relationship Model**: E.R. model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model. | **7** |
| **UNIT 2** | **Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL. | **7** |
| **UNIT 3** | **Data Base Design:** Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design. | **6** |

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|---|---|---|
| **UNIT 4** | **File Organization, Indexing and Hashing:** Overview of file organization techniques, Indexing and Hashing Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management. | **10** |
| **UNIT 5** | **Transaction processing concepts:** Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling. | **6** |
| **UNIT 6** | **Concurrency Control Techniques:** Locking Techniques for concurrency control, time stamping protocols for concurrency control, concurrency control in distributed systems. multiple granularities and multi-version schemes. | **6** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Elmasri, Navathe,"Fundamentals of Database systems", Addision Wesley | 2016 |
| **2** | Korth, Silberchatz, Sudarshan,"Data base concepts", McGraw-Hill. | 2010 |
| **3** | Ramakrishna, Gehkre, "Database Management System", McGraw-Hill | 2014 |
| **4** | Date C.J.,"An Introduction to Database systems" | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Computer Vision and Applications** | **L** | **T** | **P** | Basic of Linear Algebra and Programming |
| | **3** | **0** | **2** | |
| | | | | |
| **Course Objective:**To introduce fundamentals of computer vision so that students will understand to program a computer for understanding a scene or features in an image development. | | | | |

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To describe Image Formation Models, Monocular imaging system, Orthographic & Perspective projections. |
| **CO2** | To evaluate applications of 2D/3D Vision Filters, Binary Images, Features and Edge Detection |
| **CO3** | To describe Image Processing and Feature Extraction concepts |
| **CO4** | To analyze motion Estimation, Regularization theory, Optical computation, Stereo Vision |

| | |
|---|---|
| **CO5** | To investigate Shape Representation Segmentation, Deformable curves and surfaces |
| **CO6** | To explain about Object recognition, describe Hough transforms and other simple object recognition methods |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Intorduction to Image Processing and Computer Vision, 2D/3D Vision: Filters, Binary Images, Features, Edge Detection, Texture, Shape, Segmentation, Clustering, Model Fitting, Probabilistic, 3D Vision:Multiview geometry, Stereo, Shape from X, 3D data | **8** |
| **UNIT 2** | Image Processing and Feature Extraction: Image representations (continuous and discrete), Linear Filters, Texture, Edge detection. | **6** |
| **UNIT 3** | Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion. | **6** |
| **UNIT 4** | Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi- resolution analysis. | **8** |
| **UNIT 5** | CV Applications: Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition | **8** |
| **UNIT6** | CV Applications: Pose Estimation, Converting 2D images into 3D models, Image transformation using GANs, Computer Vision for traffic monitoring tools, Medical Image analysis. | **6** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Computer Vision: A Modern Approach by D. A. Forsyth and J. Ponce, Prentice Hall | 2011 |
| **2** | Computer Vision by Linda Shapiro and George Stockman, Prentice-Hall | 2001 |
| **3** | Robot Vision, by B. K. P. Horn, McGraw-Hill., 1986 | 1986 |
| **4** | Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press | 2004 |
| **5** | Computer vision: principles, algorithms, applications, learning by E.R. Davies | 2018 |

## SIXTH SEMESTER

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Engineering and Analytics** | **L** | **T** | **P** | Probability, Statistics, Linear Algebra |
| | **3** | **0** | **2** | |

**Course Objective:** 1. To familiarize with the concepts of data mining, data storage, data pipeline and data integration.
2.To analyze data using classification, clustering, feature selection, association rule mining and itemset mining.
3. To understand and explore data warehousing architectures and data lakes.

| S. NO. | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to understand and describe data mining, data storage, data pipeline and data integration concepts. |
| **CO2** | Ability to understand and implement classification and clustering algorithms for analyzing linearly and non-linearly separable data. |
| **CO3** | Ability to understand and implement feature selection algorithms for data reduction. |
| **CO4** | Ability to understand and explore patterns and dependencies in data using association-rule mining and itemset-mining. |
| **CO5** | Ability to understand, explore and describe data warehousing architectures and data lakes. |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to data engineering:** Storing data, Data loading, Data transformation, Data structures, SQL and NoSQL databases, Database normalization, Data cubes, Snowflake scheme, Data warehouses, Data lakes, Data Marts, Metadata in Data Warehouse, Data pipeline, Data integration- Extract, Transform, and Load (ETL) processes for integrating data from multiple sources. | **10** |
| **UNIT 2** | **Advanced data analytics and machine learning:** Cluster Analysis, Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods. Classification techniques for linearly separable and non-linearly separable data- Linear Discriminant Analysis and Support Vector Machine. Feature Ranking and Feature Selection Algorithms. Associations and correlations- basic concepts, efficient and scalable frequent item sets mining methods, mining various kinds of association rules, constraint-based association mining. | **12** |
| **UNIT 3** | **Data warehousing**: Planning Your Data Warehouse, The Data Warehouse Project, Architectural Components: Understanding Data Warehouse Architecture, Infrastructure Supporting Architecture, Collection of Tools. Indexing the data warehouse, performance enhancement techniques. | **10** |

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|---|---|---|
| **UNIT 4** | **Data design and data preparation**: From Requirements to Data Design, The STAR Schema, STAR Schema Keys, Advantages of the STAR Schema. Data modeling for data warehouses. Scalable data engineering solutions - handling massive datasets. Online Analytical Processing models, Online Transaction Processing models. . | **10** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, 3rd ed., *Morgan Kaufmann* | 2022 |
| **2** | Mining Introductory and Advanced Topics, M.H. Dunham, Pearson Education. | 2002 |
| **3** | Data mining, Pieter Adriaans, Pearson Education. | 1996 |
| **4** | Data warehousing in the real world for building decision support systems, Sam Anahory, Pearson Education. | 1997 |
| **5** | The Data Warehouse Lifecycle toolkit, Ralph Kimball, John Wiley. | 1996 |
| **6** | Fundamentals of database systems, Ramez Elmasri, Pearson Education. | 2000 |
| **7** | Oracle8 data warehousing, Michael Corey, Tata McGraw Hill. | 1998 |
| **8** | Data Warehousing Fundamentals, Paulraj Ponniah, John Wiley. | 2001 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Cyber Security** | **L** | **T** | **P** | **-** |
| | **3** | **1** | **0** | |

**Course Objective:** To learn the foundation of Cyber security and threat landscape and develop skills in students that can help them plan,implement,and monitor cyber security mechanisms to ensure the protection of information technology assests and responsible use of social media networks.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Students would be able to understand the concept of Cyber Security and issues challenges associated with it. |

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|---|---|
| **CO2** | Able to understand the cyber crimes,their nature,legal remedies,and as to how report the crimes through platforms. |
| **CO3** | Able to appreciate various privacy and security concerns on online social media,reporting on inappropriate content |
| **CO4** | Able to understand E-Commerce and didital payments and in their frauds and security issues,RBI guidelines |
| **CO5** | Able to understand the basic security aspects,use basic tools and technologies to protect their devices |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Cyber Security: Defining Cyberspace & Overview of Computer, Architecture of Cyberspace, Communication & Web Technology, Internet, World Wide web,Advent of Internet Infrastructure for data transfer, governance&society, Regulation of cyberspace,Concept,Issues & challenges of Cyber Security | **6** |
| **UNIT 2** | Cyber Crime & Cyber Laws: Classification of cyber crimes,Common cyber crimes-cyber crime targeting computers and mobiles,cyber crime against women and children,financial frauds,social engineering attacks,malware and ransomware attacks,zero day and zero click attacks,Cybercriminals and modus-operandi,Reporting of cyber crimes,Remedial and mitigation measures,Legal perespective of cyber crime and offences,Organisations dealing with Cyber crime and Cyber Security in India,Case Studies | **10** |
| **UNIT 3** | Social Media Overview&Security:Introduction to Social Networks,Types of Social Media,Social media Platforms,Social Media monitoring,Hashtag,Viral Content,Social media marketing,media privacy,Challenges,oppurtunities,pitfall in online social network,Security issues,flagging,reporting inappropriate content,best practices for the use of social media,case studies | **6** |
| **UNIT 4** | E-Commerce & Digital Payments:Defination of ECommerce,Main Components,Elements,security,threats,security best practices,Introduction to digital payments,Components of digital payment and stake holders,Models of digital payments-Banking Cards,Unified Payment Interface(UPI),e-Wallets,Unstructured Supplementary Service Data(USSD),Aadhar enabled payments,frauds&preventive measures,RBI guidelines on digital payments and customer protection in unauthorised banking transactions.Relevant provisions of payment Settlement Act,2007. | **10** |
| **UNIT 5** | Digital Devices Security Tools&Technologies for Cyber Security: End point device and mobile phone security,Password policy,security patch management, Data backup, Downloading Management of third party software,Device Security policy,Cyber Security best practices, Significance & Managment of host firewall & Anti-virus, Wi-Fi Security, Configuration of basic security policy permissions | **10** |

| | | |
|---|---|---|
| | **Total** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Cyber Crime Impact in the New Milennium, by R.C.Mishra, Auther Press | 2010 |
| **2** | Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perespectives by Sumit Belapure and Nina Godbole, Wiley India Pvt.Ltd. | 2011 |
| **3** | Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliveer, Create Space Independent Publishing Platform. | 2001 |
| **4** | Fundamentals of Network Security by E.Maiwald,McGraw Hill | 2004 |

## DEPARTMENT ELECTIVE COURSE-2,3

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| | **L** | **T** | **P** | |
| **Distributed and Cloud Computing** | **3** | **1** | **0** | Basic knowledge of programming, understanding of operating systems, Database and computer |

**Course Objective:** 1)To provide students with a solid foundation in the principles and practices of distributed and cloud computing.
2) To equip students with the knowledge and skills to design, develop, and manage distributed systems and cloud-based applications.
3) To introduce students to distributed algorithms, middleware, and data consistency mechanisms.
4) To explore cloud architecture, storage solutions, and cloud security challenges.
5) To examine advanced topics in distributed and cloud computing, including edge computing, containerization, and big data.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts and architectures of distributed and cloud computing. |
| **CO2** | Design and implement distributed algorithms and middleware solutions. |
| **CO3** | Develop and manage cloud-based applications, leveraging cloud architecture and storage solutions. |
| **CO4** | Apply security measures to protect distributed and cloud systems. |
| **CO5** | Explore advanced topics and emerging trends in distributed and cloud computing, preparing for future challenges in the field. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | **Unit 1: Introduction to Distributed Systems**<br>Overview of Distributed Computing: Definitions, Characteristics, and Applications<br>Distributed System Architectures: Client-Server, Peer-to-Peer, and Hybrid Models<br>Communication in Distributed Systems: RPC, RMI, and Message Passing<br>Synchronization in Distributed Systems: Clock Synchronization, Logical Clocks, and Distributed Mutual Exclusion<br>Fault Tolerance and Recovery in Distributed Systems: Checkpointing, Replication, and Consensus Algorithms | **10** |
| UNIT 2 | **Unit II: Introduction to Cloud Computing**<br>Overview of Cloud Computing: Definitions, Characteristics, and Service Models (IaaS, PaaS, SaaS)<br>Cloud Deployment Models: Public, Private, Hybrid, and Community Clouds<br>Virtualization in Cloud Computing: Concepts, Hypervisors, and Virtual Machine Management<br>Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)<br>Economic and Business Models of Cloud Computing: Cost-Benefit Analysis, Pricing Models, and SLA Management | **12** |
| UNIT 3 | **Unit III: Distributed Algorithms and Middleware**<br>Distributed Algorithms: Leader Election, Consensus Algorithms (Paxos, Raft), and Distributed Hash Tables (DHTs)<br>Middleware for Distributed Systems: Definition, Components, and Examples<br>Data Consistency and Replication in Distributed Systems: CAP Theorem, Consistency Models, and Quorum-Based Protocols<br>Security in Distributed Systems: Threats, Encryption, and Authentication Mechanisms<br>Case Studies: Middleware Platforms (CORBA, Java RMI, Microsoft DCOM) and their Applications. | **10** |
| UNIT 4 | **Unit IV: Cloud Architecture and Storage**<br>Cloud Architecture: Cloud Infrastructure, Resource Management, and Virtualization<br>Cloud Storage: Data Storage Systems in Cloud, Distributed File Systems (HDFS, GFS), and NoSQL Databases<br>Cloud Security: Security Issues, Data Protection, and Identity and Access Management (IAM)<br>Cloud Application Development: Tools, Frameworks, and Best Practices<br>Case Studies: Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure | **10** |

| | | |
|---|---|---|
| **UNIT 5** | **Unit V: Advanced Topics in Distributed and Cloud Computing**<br>Edge and Fog Computing: Concepts, Architectures, and Use Cases<br>Serverless Computing: Function as a Service (FaaS) and Event-Driven Architectures<br>Containerization and Orchestration: Docker, Kubernetes, and Microservices<br>Big Data and Cloud Computing: Hadoop, Spark, and Data Analytics in the Cloud<br>Future Trends in Distributed and Cloud Computing: AI Integration, Blockchain, and Quantum Computing | **10** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Coulouris, G., Dollimore, J., & Kindberg, T. Distributed Systems: Concepts and Design (6th ed.). Pearson. ISBN: 978-0132143011. | 2022 |
| **2** | Tanenbaum, A. S., & Van Steen, M. Distributed Systems: Principles and Paradigms (3rd ed.). Pearson. ISBN: 978-0132392275. | 2021 |
| **3** | Rajkumar, B., Yeo, C. S., & Venugopal, S. Cloud Computing: Principles and Paradigms (2nd ed.). Wiley. ISBN: 978-1119524984. | 2020 |
| 4 | Erl, T., Puttini, R., & Mahmood, Z. Cloud Computing Design Patterns (1st ed.). Prentice Hall. ISBN: 978-0133858567. | 2023 |
| **5** | Hwang, K., Dongarra, J., & Fox, G. C. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things (2nd ed.). Morgan Kaufmann. ISBN: 978-0128002049. | 2022 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Pattern Recognition** | **L** | **T** | **P** | Linear Algebra, Probability Theory |
| | **3** | **0** | **2** | |

**Course Objective:** To equip with basic mathematical and statistical techniques commonly used in pattern recognition. Also provide with an adequate background on probability theory, statistics, and optimization theory to tackle a wide spectrum of engineering problems.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Able to apply the knowledge of mathematics for obtaining solutions in pattern recognition domain |
| **CO2** | Able to apply various algorithms for pattern recognition |
| **CO3** | Able to map the pattern recognition concepts for solving real life problems |

| | |
|---|---|
| **CO4** | Able to carry out implementation of algorithms using different simulation tools |
| **CO5** | To effectively implement pattern recognition algorithms for specific applications |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Pattern Recognition, Feature Detection, Classification, Review of Probability Theory, Conditional Probability and Bayes Rule, Random Vectors, Expectation, Correlation, Covariance, Review of Linear Algebra, Basics of Estimation theory, Decision Boundaries, Decision region / Metric spaces/ distances. | **10** |
| **UNIT 2** | Classification: Bayes decision rule, Error probability, Normal Distribution, Discriminant functions, Decision surfaces, K-NN Classifier, Single Layer Perceptron, Multi-Layer Perceptron, Training set, test set; standardization and normalization. | **8** |
| **UNIT 3** | Clustering: Basics of Clustering; similarity / dissimilarity measures; clustering criteria, Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means algorithm, K-medoids, DBSCAN, Data sets - Visualization; Unique Clustering, No existence of clusters. | **8** |
| **UNIT 4** | Feature selection: Problem statement and Uses; Algorithms - Branch and bound algorithm, sequential forward / backward selection algorithms, (l,r) algorithm; Probabilistic separability based criterion functions, interclass distance based criterion functions. | **8** |
| **UNIT 5** | Feature extraction: PCA, Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy techniques, and real-life examples. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | R. O. Duda, P. Hart, D. Stork, Pattern Classification, 2nd Ed. Wiley, ISBN: 978 0-471-05669-0.,2000 | 2000 |
| **2** | Bishop, C. M., Pattern Recognition and Machine Learning. Springer, ISBN 978- 0- 387-31073-2,2007 | 2007 |
| **3** | Bishop, C. M., Neural Networks for Pattern Recognition, Oxford University Press, ISBN-13: 978-0198538646,1995 | 1995 |
| **4** | Theodoridis, S. and Koutroumbas, K., Pattern Recognition, 4th Ed. Academic Press, ISBN :9781597492720.,2008 | 2008 |

| **B.Tech. Information Technology** | | |
|---|---|---|
| **Course code: Course Title** | **Course Structure** | **Pre-Requisite** |

| Secure Coding | L | T | P | Basic knowledge of programming, operating systems & computer networks. |
|---|---|---|---|---|
| | 3 | 1 | 0 | |

**Course Objective:** 1) To understand the principles and practices of secure coding.
2)To learn how to identify and mitigate common security vulnerabilities in software applications.
3) To study secure software development methodologies and tools.
4) To gain hands-on experience in writing secure code across different programming languages.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand and apply secure coding principles in software development. |
| **CO2** | Identify and mitigate common security vulnerabilities in software applications. |
| **CO3** | Use secure software development tools and techniques effectively. |
| **CO4** | Contribute to the creation of secure software that meets industry standards. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to Secure Coding**<br>Overview of Software Security:Importance of software security in modern applications. Common types of software vulnerabilities. The cost of insecure software. Principles of Secure Coding: Least Privilege, Defense in Depth, Secure by Default. Security policies and secure coding standards (e.g., CERT). Secure Software Development Life Cycle (SSDLC): Stages of SSDLC and their importance. Threat modeling and risk assessment.ecure design principles. | **10** |
| **UNIT 2** | **Common Security Vulnerabilities**<br>Buffer Overflows: Stack-based and heap-based buffer overflows. Prevention techniques: Bounds checking, use of safe libraries. Injection Flaws:<br>SQL Injection, Command Injection, Cross-Site Scripting (XSS).Input validation and sanitation techniques. Cross-Site Request Forgery (CSRF) and Cross-Site Scripting (XSS): Understanding CSRF and XSS attacks. Methods to prevent CSRF and XSS vulnerabilities. | **12** |
| **UNIT 3** | **Unit III: Secure Coding in Various Programming Languages**<br>Secure Coding in C/C++:Handling pointers, memory management, and input validation.Avoiding common pitfalls like null pointers, integer overflows.<br>Secure Coding in Java: Security Manager and sandboxing.<br>Avoiding common vulnerabilities in Java: Deserialization, improper resource shutdown. Secure Coding in Web Languages (JavaScript, PHP): Protecting against XSS, CSRF, and other web vulnerabilities. Safe handling of user inputs and data sanitization. | **10** |

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|---|---|---|
| **UNIT 4** | **Unit IV: Cryptography and Secure Data Handling**<br>Basics of Cryptography: Symmetric and Asymmetric encryption.<br>Key management and Public Key Infrastructure (PKI).<br>Hashing and Digital Signatures: Importance of hashing in security.<br>Implementing and using digital signatures.<br>Secure Data Storage:Encrypting data at rest and in transit. Secure use of cookies and session management. | **10** |
| **UNIT 5** | **Unit V: Secure Software Testing and Auditing**<br>Security Testing Techniques: Static and dynamic analysis tools.<br>Fuzz testing, Penetration testing, and Code reviews.<br>Vulnerability Assessment and Ethical Hacking: Tools and methodologies for vulnerability scanning. Reporting and mitigating identified vulnerabilities.<br>Case Studies and Best Practices: Real-world case studies of security breaches.<br>Industry best practices for secure software development. | **10** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | "Software Security: Building Security In" by Gary McGraw, Addison-Wesley | 2006 |
| **2** | "The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities" by Mark Dowd, John McDonald, Justin Schuh, Addison-Wesley | 2006 |
| **3** | "Hacking: The Art of Exploitation, 2nd Edition" by Jon Erickson, No Starch Press | 2008 |
| 4 | "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2nd Edition" by Dafydd Stuttard, Marcus Pinto, Wiley | 2011 |
| **5** | "Secure Coding in C and C++, 2nd Edition" by Robert C. Seacord, Addison-Wesley | 2013 |
| **6** | "Effective Java, 3rd Edition" by Joshua Bloch, Addison-Wesley. | 2017 |
| 7 | "Web Security for Developers: Real Threats, Practical Defense" by Malcolm McDonald, No Starch Press | 2020 |
| **8** | "Cryptography and Network Security: Principles and Practice, 8th Edition" by William Stallings, Pearson | 2020 |
| **9** | "The Art of Software Security Testing: Identifying Software Security Flaws, 1st Edition" by Chris Wysopal, Lucas Nelson, Addison-Wesley | 2006 |
| **10** | "Penetration Testing: A Hands-On Introduction to Hacking" by Georgia Weidman, No Starch Press | 2014 |

| Course code: Course Title | Course Structure | | | Pre-Requisite |
|---|---|---|---|---|
| **Wireless Ad hoc Mobile Network** | **L** | **T** | **P** | **Fundamental of Computer Networks** |
| | **3** | **-** | **2** | |

**Course Objective:** (1) Explain the fundamental principles of Ad-hoc Networks. (2) Discuss the comprehensive understanding of Ad-hoc network protocols. (3) Outline the current and emerging trends in Ad-hoc Ad-hoc Networks. (4) Analyze the energy management techinques in ad-hoc wireless networks.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Design their own wireless network |
| **CO2** | Choose appropriate protocol for various applications |
| **CO3** | Evaluate the existing network and improve its quality of service |
| **CO4** | Examine security measures present at different level and analyze energy consumption and management |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols. | **9** |
| **UNIT 2** | Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols. | **8** |
| **UNIT 3** | Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols | **8** |
| **UNIT 4** | Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless etworks,<br>Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks. | **8** |

| | | |
|---|---|---|
| **UNIT 5** | Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management chemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes | **9** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education | 2011 |
| **2** | C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education | 2002 |
| **3** | Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley | 2007 |
| **4** | Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers | 2004 |
| **5** | Wireless Ad Hoc Mobile wireless Networks- principle, protocols and applications, Subir Kumar Sarkar , et al.,Auerbach publications, Taylor & Francis Group | 2008 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Blockchain Technology** | **L** | **T** | **P** | Cryptography |
| | **3** | **1** | **0** | |

**Course Objective**: This course provides a comprehensive introduction to blockchain technology, covering its fundamental concepts, key platforms, and cryptographic solutions. Students will explore security, privacy, scalability, and interoperability challenges, along with the consensus protocols that maintain blockchain integrity. By the end of the course, students will be prepared to understand and apply blockchain technology in various real-world scenarios.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To understand the fundamentals of blockchain technology. |

| | |
|---|---|
| **CO2** | To acquire the knowledge on various blockchain platforms. |
| **CO3** | To study the Cryptographic Solution in Blockchain and understand their security and privacy issues. |
| **CO4** | To study the various consensus protocols used in the blockchain technology. |
| **CO5** | To understand the scalability, interoperability issues and their proposed solutions in current scenarios. |

| S. NO | Contents | Contact H... |
|---|---|---|
| **UNIT 1** | Introduction: Decentralised System: Difference between centralised, decentralised and distributed system, Introduction and need of decentralised ledger system. Blockchain Technology: Introduction of blockchain, Architecture of Blockchain, detailed knowledge of Block Structure, Working of Blockchain, main barrier to blockchain adoption, use-case of blockchain in various fields. | **8** |
| **UNIT 2** | Blockchain Platform: Introduction of Public/permissionless, Private/Permissioned Ethereum: Basics, Ethereum clients, Wallets, Tokens, Oracles, Ethereum Virtual Machine, Smart Contract, Introduction to Solidity | **8** |
| **UNIT 3** | Cryptography: Public key cryptography, Digital Signature, Hashing, SHA256, AES, RSA, Security and privacy: Issues in blockchain, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks, Smart Contract Vulnerability, Hard fork/ soft Fork, Mitigatation Techniques. | **8** |
| **UNIT 4** | Consensus: Foundation od Consensus, Classical Consensus, Nakamoto Consensus, Ethereum Merge, Blockchain Selfish Mining, Proof based consensus: PoW, Pos, PoA, PoET, Voting Based Consensus: Paxos, RAFT, PBFT | **10** |
| **UNIT 5** | Scalability and Interoperability: Addressing the Issue of Scalability and Interoperability, Blockchain scalability solutions: Layer 1, Layer 2, Various Off-chain Storage. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication/... |
|---|---|---|
| **1** | Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities, to DeFi, NFTs and Web3, 4th Edition "imran bashir", Packt Publishing | 2023 |
| **2** | Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos and Gavin Wood, Shroff/O'Reilly | 2018 |
| **3** | Mastering Bitcoin: Programming the Open Blockchain (Second Edition) "Andreas Antonopoulos", O'Reilly Media | 2017 |

| Course code: Course Title | Course Structure | | | Pre-Requisite |
|---|---|---|---|---|
| | L | T | P | |
| Digital Image Processing | 3 | - | 2 | - |

**Course Objective:**To introduce to the concepts of digital image processing. The students will learn image transforms, image enhancement,restoration, morphological operations, edge detection, and segmentation algorithms.

| S. NO | Course Outcomes (CO) |
|---|---|
| CO1 | Understand the fundamental concepts of digital image representation, sampling, quantization, and basic image relationships. |
| CO2 | Apply spatial domain techniques, including gray level transforms, histogram operations, and fuzzy logic, for enhancing digital images. |
| CO3 | Utilize frequency domain techniques, including Fourier transforms, for image enhancement through filtering, smoothing, and sharpening. |
| CO4 | Implement noise removal algorithms and color models to restore degraded images and enhance color images. |
| CO5 | Apply morphological operations such as dilation, erosion, and boundary extraction to process and analyze digital images. |
| CO6 | Detect edges, points, and lines using various operators, and apply image segmentation techniques for partitioning digital images. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | **Introduction And Digital Image Fundamentals:** Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital image processing systems, Sampling and quantization, some basic relationships like neighbours, connectivity, Distance measure between pixels, Imaging Geometry. | 6 |
| UNIT 2 | **Image Enhancement (Spatial Domain):** Gray level transforms, histogram equalization, histogram specification, basics of the spatial filtering, smoothing operators, image gradients, sharpening operators **Fuzzy logic:** basic definitions, fuzzy operations, fuzzy inference, application of fuzzy logic in image processing. | 7 |
| UNIT 3 | **Image Enhancement (Frequency domain):** Two-Dimensional Fourier transform and its properties, basics of frequency domain filtering, smoothing and sharpening in frequency domain | 7 |

| | | |
|---|---|---|
| **UNIT 4** | **Image Restoration:** modelling of image degradations, noise models, noise removal algorithms for impulse and Gaussian noise, Adaptive filtering, estimation of degradation function, inverse filtering.<br>**Color Image Processing:** Color models, conversion between different models, color transforms, color smoothing and sharpening. | **8** |
| **UNIT 5** | **Morphological Image Processing:** Dilation, Erosion, opening and closing, hit and miss transform, boundary extraction, region filling, thinning, thickening, skeletons, pruning, Gray scale image dilation and erosion. | **6** |
| **UNIT 6** | **Discontinuity Detection:** point, line and edge detection, Sobel, Canny, and LoG edge detectors, edge linking.<br>**Image Segmentation:** Thresholding, optimal and global thresholding, multiple thresholding, region growing, region splitting and merging, dam construction watershed segmentation algorithm, spatial techniques, frequency domain techniques. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', 3rd Edition, Pearson Education | 2008 |
| **2** | Anil K. Jain, Fundamentals of Digital Image Processing', Pearson | 2002 |
| **3** | William K. Pratt, Digital Image Processing' 6th Edition, John Wiley | 2002 |
| **4** | Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB, Pearson | 2004 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Natural language processing** | **L** | **T** | **P** | Probability and statistics, Machine learning |
| | **3** | **1** | **0** | |

**Course Objective:** 1. To familiarize with basic text pre-processing steps and pattern matching using regular expressions
2.To design grammar based text parsing systems.
3. To understand, design and implement machine learning based text classification and text generation systems.

| **S. NO.** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Ability to understand and implement text pre-processing techniques and pattern matching using regular expressions. |

| | |
|---|---|
| **CO2** | Ability to implement Bag-of-Words models for feature extraction and machine learning for text classification. |
| **CO3** | Ability to analyze the use of word senses and word embeddings with sequence learning using LSTM or transformer. |
| **CO4** | Ability to execute syntactic parsing of sentences for a given grammar and probabilistic inferencing. |
| **CO5** | Ability to design and implement text generation models using Language modelling and encoder-decoder models. |
| **CO6** | Ability to describe real-world applications of Natural Language Processing and Natural Language Generation. |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction:** The study of Language, Introduction to NLP and various terms related to NLP- morphology, syntax, semantics, pragmatics, discourse, ambiguity. Regular Expression, Finite State Automata. | **6** |
| **UNIT 2** | **Text representation and classification**: Pre-processing: Tokenization, Lemmatization, Stemming. Frequency Based Methods: Bag-of-Words features, 1-hot encoding, TF, TF-IDF, Machine learning classifiers. Sequence Based Methods: Word Embeddings, LSTM/Transformer. | **8** |
| **UNIT 3** | **Lexical Semantics**: Word Senses, WordNet, SentiWordNet, Synsets, Hypernyms, Hyponyms, Meronyms, Holonyms, Word Sense Disambiguation, Word Similarity, Semantic Role Labelling. | **8** |
| **UNIT 4** | **Natural language generation:** Probabilistic Context-Free Grammars, Syntactic Parsing, Part-of-speech-tagging, Probabilistic Language Processing, N-gram language modelling for text generation. Encoder-decoder LSTM/Transformer models for sequence-to-sequence learning, Attention mechanism. | **12** |
| **UNIT 5** | **Advanced techniques:** Large Language Models, Machine Translation, Man-Machine Interfaces, Natural language Question-Answering Systems, Text summarization models, Information Retrieval. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | D. Jurafsky, J. H. Martin, Speech and Language Processing, 2/e, Pearson Education. | 2013 |
| **2** | James Allen, Natural Language Understanding, 2/e, Pearson Education. | 2003 |

| | | |
|---|---|---|
| **3** | S. Bird, E. Klein, E. Loper, "Natural Language Processing with Python", O'Reilly. | 2009 |
| **4** | Manning and Schutze, "Foundation of Statistical Natural Language Processing", MIT press. | 1999 |
| **5** | U. Kamath, J. Liu, J. Whitaker, "Deep learning for NLP and speech recognition", Springer. | 2019 |
| **6** | D. Rothman, "Transformers for Natural Language Processing", Packt publishing. | 2021 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Cyber Digital Forensics** | **L** | **T** | **P** | |
| | **3** | **0** | **2** | |

**Course Objective:** Upon completion, students will understand digital forensics principles and real-world crime examples, address challenging aspects like encryption and jurisdiction, and apply investigation processes using various forensic tools in Windows and UNIX environments.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To employ various forensic tools and technologies in practical scenarios, ensuring the integrity and admissibility of digital evidence in legal proceedings. |
| **CO2** | To develop an understanding of various types of computer forensics enabling them to effectively analyze digital evidence from diverse sources |
| **CO3** | Students will be proficient in conducting live data collection and analysis in Windows environments. |
| **CO4** | Students will be proficient in conducting live data collection and analysis in Unix environments. |
| **CO5** | To demonstrate proficiency in conducting ethical hacking activities, including port scanning and vulnerability assessments using tools. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to Digital forensics, Digital evidence and investigations, Real life examples of digital crime, Challenging aspects of digital forensics. Introduction to intellectual property rights and professional ethics. | **8** |
| **UNIT 2** | Computer crime investigation process: The Investigation process, preparing a computer investigation.<br>Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations). Digital forensics of image, audio etc files. | **9** |

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|---|---|---|
| **UNIT 3** | Live Data collection and investigating windows environment: windows Registry analysis, Gathering Tools to create a response toolkit ( Built in tools like netstat , cmd.exe , nbtstat , arp , md5sum ,regdmpetc and tools available as freeware like Fport , Pslistetc) | **9** |
| **UNIT 4** | Live Data collection and investigating UNIX environment Forensic tools and report generation: Recovery of Deleted files in windows, Analyzing network traffic, sniffers | **8** |
| **UNIT 5** | Ethical Hacking, Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap ,Netscanetc .Password recovery, Mobile forensic tools. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Mandia, Kevin, Prosise, Chris, and Pepe, Matt," Incident Response &Computer Forensics", McGraw-Hill. | 2003 |
| **2** | Beebe, Nicole Lang, and Jan Guynes Clark, "A Hierarchical, Objectives-Based Framework for the Digital Investigations Process | 2005 |
| **3** | Nelson, Bill, Amelia Phillips, Frank Enfinger, and Christopher Steuart," Guide to Computer Forensics and Investigations", Thompson Course Technology, Boston | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Computer Vision** | **L** | **T** | **P** | Basic of Linear Algebra and Programming |
| | **3** | **0** | **2** | |

**Course Objective:**To introduce fundamentals of computer vision so that students will understand to program a computer for understanding a scene or features in an image development.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To describe Image Formation Models, Monocular imaging system, Orthographic & Perspective projections |
| **CO2** | To evaluate applications of 2D/3D Vision Filters, Binary Images, Features and Edge Detection |
| **CO3** | To describe Image Processing and Feature Extraction concepts |
| **CO4** | To analyze motion Estimation, Regularization theory, Optical computation, Stereo Vision |

| | |
|---|---|
| **CO5** | To investigate Shape Representation Segmentation, Deformable curves and surfaces |
| **CO6** | To explain about Object recognition, describe Hough transforms and other simple object recognition methods |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Image Formation Models: Monocular imaging system, Orthographic & &Perspective Projection, Cameras – lenses, projections, sensors, Radiometry –Measuring Light, light and surfacesRepresentation – color spaces, Camera model and Camera calibration, Binocular imaging systems, Sources, Shadows and Shading. | **8** |
| **UNIT 2** | 2D/3D Vision: Filters, Binary Images, Features, Edge Detection, Texture, Shape, Segmentation, Clustering, Model Fitting, Probabilistic, 3D Vision:Multiview geometry, Stereo, Shape from X, 3D data | **6** |
| **UNIT 3** | Image Processing and Feature Extraction: Image representations (continuous and discrete), Linear Filters, Texture, Edge detection. | **6** |
| **UNIT 4** | Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion. | **8** |
| **UNIT 5** | Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi- resolution analysis. | **8** |
| **UNIT6** | Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition. | **6** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Computer Vision: A Modern Approach by D. A. Forsyth and J. Ponce, Prentice Hall, 2003/2011 | 2011 |
| **2** | Computer Vision by Linda Shapiro and George Stockman, Prentice-Hall, 2001 | 2001 |
| **3** | Robot Vision, by B. K. P. Horn, McGraw-Hill., 1986 | 1986 |
| 4 | Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004 | 2004 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Artificial Intelligence** | **L** | **T** | **P** | Data Structures and Algorithms |
| | **3** | **0** | **2** | |

**Course Objective:** To provide the foundations for AI problem solving techniques and knowledge representation formalisms.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Identify and formulate appropriate AI methods for solving a problem. |
| **CO2** | Implement AI algorithm |
| **CO3** | Compare different AI algorithms in terms of design issues, computational complexity, and assumptions |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Uninformed search strategies, Greedy best-first search, And-Or search, Uniform cost search, A* search, Memory-bounded heuristic search. Local Search Techniques: Beam Search, Hill Climbing Search, Genetic Search techniques. Constraint Satisfaction Problems: Backtracking search for CSPs, Local search for CSPs | **12** |
| **UNIT 2** | Adversarial Search: Optimal Decision in Games, The minimax algorithm, Alpha-Beta pruning, Expectimax search. Knowledge and Reasoning: Propositional Logic, Reasoning Patterns in propositional logic; First order logic: syntax, semantics, Inference in First order logic, unification and lifting, backward chaining, resolution | **12** |
| **UNIT 3** | Representation: Information extraction, representation techniques, foundations of Ontology, Planning: Situation Calculus, Deductive planning, STRIPES, sub-goal, and Partial order planner. Bayesian Network and causality: Probabilistic models, directed and undirected models, inferencing, reasoning, causality | **12** |
| **UNIT 4** | Reinforcement Learning: MDP, Policy, Q-value | **6** |
| | **TOTAL** | **42** |

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | Artificial Intelligence: A Modern Approach by Russell and Norvig Pearson | 2022 |
| 2 | Artificial Intelligence by Kevin Knight, Elaine Rich, and Shivashankar B. Nair, McGraw Hill Education | 2017 |
| **3** | Introduction to Artificial Intelligence by Wolfgang Ertel, Springer | 2011 |
| **4** | Artificial Intelligence: Foundations of Computational Agents by David L. Poole and Alan K. Mackworths, Cambridge University Press | 2017 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Software Testing** | **L** | **T** | **P** | **-** |
| | **3** | **1** | **-** | |

**Course Objective:** To understand software testing concepts and applications.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts of verification and validation, including terminologies, goals, roles, and applicability in software testing. |
| **CO2** | Comprehend the software testing process, levels of testing, and testing activities, including debugging and stress testing. |
| **CO3** | Apply verification methods and functional testing techniques like boundary value analysis and equivalence class testing to ensure software quality. |
| **CO4** | Implement structural testing methods, including path testing, cyclomatic complexity, and object-oriented testing techniques. |
| **CO5** | Evaluate and utilize various testing tools and methodologies for automated testing and debugging in software projects. |
| **CO6** | Prioritize test cases and apply advanced testing techniques for web applications and automated test data generation. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | **Introductory concepts:** Verification &Validation Terminologies like Goals, Role, Objectives, Limitations, Approaches & Applicability. | **4** |
| **UNIT 2** | **Software Testing:** Testing Process, Limitations of Testing, Testing activities. **Levels of Testing:** Unit Testing, Integration Testing, System Testing, Debugging, Domain Testing, Regression Testing, Stress Testing, Slice based testing | **8** |

| | | |
|---|---|---|
| **UNIT 3** | **Verification Testing:** Verification Methods, SRS Verification, Software Design Document Verification, Code Reviews, User Documentation Verification, Software Project Audits.<br>**Functional Testing techniques:** Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. | **8** |
| **UNIT 4** | **Structural Testing:** Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing. Object Oriented Testing: Class Testing, GUI Testing. | **8** |
| **UNIT 5** | **Testing Activities:** Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging<br>**Software Testing Tools Taxonomy:** Methodology to evaluate automated testing. Using tools: Load Runner, Win runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT Cactus and other recent tools. | **8** |
| **UNIT 6** | **Advanced Topics** on Testing: Prioritizing the Test-cases, Testing Web Applications, Automated Test Data Generation. | **6** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Paul C. Jorgenson, Software Testing A Craftsman's approach, CRC Press., | 1997 |
| **2** | Yogesh Singh, "Software Testing", 1st Ed., Cambridge University Press | 2012 |
| **3** | Louise Tamres, "Software Testing", Pearson Education Asia, | 2002 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Competitive Programming** | **L** | **T** | **P** | Data Structures, C/C++ |
| | **3** | **1/0** | **0/2** | |

**Course Objective:** To equip students with the skill to think critically and logically to solve any problem.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To understand the different data structures as per the need of the problem statement |
| **CO2** | To understand the basic and advanced level maths behind different algorithms |

| | |
|---|---|
| **CO3** | To apply dynamic programming techniques with different data structures |
| **CO4** | To efficiently retrieve and manipulate elements within a specified range in a data structure |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Number Theory and Bit Manipulation: Binary Exponentiation Modular Arithmetic, Modular Inverse, Euclidean: GCD, Euclidean: LCM, Sieve of Eratosthenes, Linear Diophantine Equation with Two Variables, Chinese Remainder Theorem, Bit operations | **10** |
| **UNIT 2** | Combinatorics and Greedy Algorithms: Stars and Bars Factorial, Binomial Coefficient (nCr), Catalan Number, Two Pointer Sliding Window | **8** |
| **UNIT 3** | Searching Techniques and algorithms: Binary Search on answer and monotonic functions, Ternary Search on Convex Functions | **8** |
| **UNIT 4** | Dynamic Programming: DP on arrays, Dp on trees, Dp on directed graph, Game DP, Digit Dp, Dp with Bitmasking | **8** |
| **UNIT 5** | Range Queries: Segment tree Sparse table, Fenwick tree, Lazy Propagation, Square root decomposition (MO's Algorithm). | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | COMPETITIVE PROGRAMMING IN PYTHON: 128 Algorithms to Develop your Coding Skills Christoph Dürr (Author), Jill-Jênn Vie (Author), Greg Gibbons (Translator), Danièle Gibbons (Translator) | 2020 |
| **2** | Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi | 2018 |
| **3** | Concrete Mathematics A textbook by Donald Knuth, Oren Patashnik, and Ronald Graham | 1994 |

## GENERIC ELECTIVE COURSE-2

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Deep Learning and Applications** | **L** | **T** | **P** | **Machine Learning** |
| | **3** | **0** | **2** | |

**Course Objective:**The primary objective of a deep learning course for undergraduate students is to equip them with a solid foundation in the theory and practical application of deep learning techniques**.**

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Demonstrate a clear understanding of the fundamental concepts of deep learning, including neural networks, activation functions, loss functions, and optimization techniques |
| **CO2** | Design, implement, and train basic neural network architectures, including feedforward networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) using modern deep learning frameworks like TensorFlow or PyTorch. |
| **CO3** | Apply deep learning techniques to solve complex problems in various domains such as image classification, object detection, natural language processing, and time-series prediction. |
| **CO4** | Explore and implement advanced deep learning techniques such as transfer learning, generative adversarial networks (GANs), attention mechanisms, and transformers to address cutting-edge research and industry challenges. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Overview of Artificial Intelligence, Machine Learning, and Deep Learning, History and evolution of deep learning, Applications of deep learning, Perceptron and multi-layer perceptron, Activation functions, Loss functions and their significance, Gradient Descent and Backpropagation, Neural Networks: Deep vs Shallow Networks, Training Deep Networks: Vanishing and Exploding Gradients, Techniques to mitigate gradient issues (Batch Normalization, Gradient Clipping), Optimization algorithms (SGD, Adam, RMSprop), Regularization techniques (L2, Dropout), and Weight Initialization | **16** |
| **UNIT 2** | Convolutional Neural Networks, and their significance in image processing, Convolution operations and feature maps. Pooling layers, CNN architectures: LeNet, AlexNet, VGG, ResNet, Inception, Transfer learning and fine-tuning pre-trained models. Introduction to Generative Adversarial Networks, Autoencoder. Variational Autoencoders. | **14** |
| **UNIT 3** | Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, Gated Recurrent Unit (GRU), Attention Mechanisms and Transformers, Sequence-to-sequence models with attention. | **12** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Deep Learning by Ian Goodfellow , Yoshua Bengio , and Aaron Courville, MIT Press (https://www.deeplearningbook.org/) | 2016 |
| **2** | Deep Learning: Foundations and Concepts by Christopher M. Bishop and Hugh Bishop, Springer | 2023 |

| | | |
|---|---|---|
| **3** | Introduction to Deep Learning by Eugene Charniak, MIT Press | 2019 |
| **4** | Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron | 2022 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Java Programming** | **L** | **T** | **P** | **OOP/C++** |
| | **3** | **0** | **2** | |

**Course Objective:** To familiarize students with Java Programming

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To introduce JAVA concepts |
| **CO2** | To use inheritance and other OOP features |
| **CO3** | To use packages and interface |
| **CO4** | To develop basic GUI using JAVA |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to Java: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java's Magic Byte code. | **10** |
| **UNIT 2** | The Java Environment: Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments. | **8** |
| **UNIT 3** | Object Oriented Programming: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects, Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. | **8** |
| **UNIT 4** | Extending Classes and Inheritance: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces. | **8** |

| | | |
|---|---|---|
| **UNIT 5** | Package: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages. GUI Programming: Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | The Complete Reference Java,, Herbert Schildt, ISBN: 978-0-07163177-8, Publisher: McGraw Hill | 7th edition |
| **2** | Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hall | 4th Edition, |
| **3** | The Java Programming Languages,, Ken Arnold, ISBN-13: 978-032134980, Publisher: Sun | 4th Edition, |
| **4** | 4. Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc. | 6th Edition |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Operating System Principles** | **L** | **T** | **P** | C Programming and Data Structures |
| | **3** | **0** | **2** | |

**Course Objective:** 1. To provide an understanding of the fundamental concepts of operating systems.
2. To provide insight into the functional modules of operating systems.
3. To study the concepts underlying the design and implementation of operating systems.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Abilty to understand the basic concepts and functions of operating systems. |
| **CO2** | Abilty to understand Processes, Threads, and Deadlocks |
| **CO3** | Abilty to analyze Scheduling algorithms |
| **CO4** | Abilty to analyze memory management schemes. |
| **CO5** | Abilty to understand I/O management and File systems. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection. Operating System Structure: System Components, System structure, Operating System Services | **6** |
| **UNIT 2** | Concurrent Processes: Process concept, Principle of Concurrency, Producer Consumer Problem, Critical Section problem, Semaphores, Classical problems in Concurrency, Inter Process Communication,<br>Process Generation, Process Scheduling.<br>CPU Scheduling: Scheduling Concept, Performance Criteria of Scheduling Algorithm, Evolution, Multiprocessor Scheduling. | **10** |
| **UNIT 3** | Deadlock: System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock combined approach. | **8** |
| **UNIT 4** | Memory Management: Base machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replacement algorithms, Allocation of frames, Thrashing, Cache memory organization, Impact on performance. | **10** |
| **UNIT 5** | I/O Management & Disk Scheduling: I/O devices and organization of I/O function, I/O Buffering, DISK I/O, Operating System Design Issues.<br>File System: File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Silberschatz, A, Galvin, P.B., Gagne G., “Operating System Concepts” 10th edition, Wiley Publishers. | 2018 |
| **2** | Stallings W, “Operating Systems “, 9th edition, Pearson Education | 2018 |
| **3** | Maurice Bach, "Design of Unix Operating System", PHI. | 2013 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Data Analysis using R** | **L** | **T** | **P** | Machine Learning |
| | **3** | **0** | **2** | |

**Course Objective:**: In this course students will learn R. Programming language, data analytics, data visualisation and statistical model for data analytics.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Apply R programming skills to import, clean, and prepare datasets for analysis. |
| **CO2** | Conduct exploratory data analysis (EDA) to discover patterns, trends, and relationships within the data. |
| **CO3** | Build and interpret visualizations using ggplot2 to summarize and present data insights. |
| **CO4** | Perform basic and advanced statistical analyses using R functions and packages. |
| **CO5** | Apply regression models and other predictive analysis techniques to solve real-world problems. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Data Analysis: Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics. | **6** |
| **UNIT 2** | R Programming Basics: Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages. | **8** |
| **UNIT 3** | Data Visualization using R: Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Histograms,Boxplots,Bar Charts, Line Graphs, Scatterplots, Pie Charts | **8** |
| **UNIT 4** | Statistics with R: Random Forest, Decision Tree, Normal and Binomial distributions,Time Series Analysis,Linear and Multiple Regression, Logistic Regression, Survival Analysis | **8** |
| **UNIT 5** | Prescriptive Analytics: Creating data for analytics through designed experiments,Creating data for analytics through active learning, Creating data for analytics through reinforcement learning | **8** |
| **UNIT 6** | Advanced Data Visualization: Advanced ggplot2 techniques: facets, multi-panel plots, custom color palettes. Visualizing time series data. Creating interactive plots using plotly or shiny. | **4** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16). URL: https://cran.rproject.org/doc/manuals/r-release/R-intro.pdf | 2013 |
| **2** | R for Data Science by Hadley Wickham, Garrett Grolemund Released December 2016 Publisher(s): O'Reilly Media, Inc. ISBN: 9781491910344 | 2016 |
| **3** | Hands-On Programming with R by Garrett Grolemund Released December 2016 Publisher(s): O'Reilly Media, | 2016 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Dependable Machine Learning** | **L** | **T** | **P** | Machine Learning |
| | **3** | **0** | **2** | |

**Course Objective:** To provide characteristic details of AI and machine learning systems to make them dependable, such as explainability, interpretability, safety etc.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Demonstrate a thorough understanding of key principles related to dependable machine learning, including explainability, interpretability, safety, and robustness |
| **CO2** | Assess and critique the reliability of machine learning models, including their performance, safety measures, and resilience to adversarial attacks |
| **CO3** | Develop machine learning models that provide explanations for their predictions and decisions, ensuring transparency and trustworthiness |
| **CO4** | Effectively communicate the reliability, limitations, and safety measures of machine learning systems to both technical and non-technical stakeholders. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction: Overview, Motivation, Challenges – medical and surveillance. Explainable AI: Accuracy-explainability, Tradeoff, Interpretability Problem, Predictability, Transparency, Traceability, Causality, Reasoning, Attention and Saliency | **10** |
| **UNIT 2** | Interpretable AI: Prediction Consistency, Application Level Evaluation, Human Level Evaluation, Function, Level Evaluation. Adversarial Robustness: Adversarial Attacks and Defenses | **10** |
| **UNIT 3** | Trustworthy AI: Integrity, Reproducibility, Accountability, Bias-free AI: Accessibility, Fair, Data Agnostics Design, Disentanglement. Privacy-Preserving AI: Federated Learning, Differential Privacy and Encrypted Computation | **12** |

| | | |
|---|---|---|
| **UNIT 4** | Verified AI: Environment and Specification Modeling, Design with Formal Inductive Synthesis, and Evaluation. Platforms for AI Safety | **10** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Fairness and Machine Learning: Limitations and Opportunities by Solon Barocas, Moritz Hardt, Arvind Narayanan, MIT Press | 2023 |
| **2** | Ethics of Artificial Intelligence by S. Matthew Liao, OUP USA | 2020 |
| **3** | Interpretable Machine Learning, by Christoph Molnar, https://www.lulu.com/ | 2020 |
| **4** | The Ethics of Artificial Intelligence by Luciano Floridi, Oxford Univ Press | 2023 |
| **5** | https://fairmlclass.github.io/ | 2022 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Embedded Systems** | **L** | **T** | **P** | Knowledge of Computer Architecture, Microprocessors |
| | **3** | **1/0** | **0/2** | |

**Course Objective:** To introduce fundamentals of embedded systems and programming fundamentals and microcontroller, concepts of program development using digital circuits and systems.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To introduce fundamentals of 16 and 32 bit Microcontrollers, assembly language programming. |
| **CO2** | Interfacing of different interrupt driven peripherals |
| **CO3** | To understand in detail Real Time Operating Systems, |
| **CO4** | To understand Bus architecture, Digital Signal Processors and System On-Chip. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction Evolution of embedded systems &their applications, architectural diversity for embedded system development. | **8** |

| | | |
|---|---|---|
| **UNIT 2** | Techniques and tools for embedded software development Embedded Programming principles, Instruction Set Architectures for embedded software development: arithmetic and logical, program control, string instructions, special or privileged instructions. | **10** |
| **UNIT 3** | Interrupt system, Input-output programming, Memory management, Using High level languages for embedded programming, structured and Object Oriented Programming. | **8** |
| **UNIT 4** | Re-configurable FPGA for embedded computing R-FPGA and hardware software development, issues in Reconfigurable computing, placement and scheduling techniques. | **8** |
| **UNIT 5** | Design of digital systems on FPGAs, fault tolerant design on FPGAs, Re-targetable assembling and compilation. Applications Specific applications,Emerging trends | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Advanced FPGA Design: Architecture, Implementation, and Optimization by Steve Kilts, Wiley. (ISBN- 978-0-470-05437-6) | 2007 |
| **2** | Practical FPGA Programming in C by David Pellerin, Prentice Hall. (ISBN-10: 0131543180,ISBN-13: 978-0131543188) | 2005 |
| **3** | Synthesis of Arithmetic Circuits: FPGA, ASIC and Embedded Systems, by Jean Pierre Deschamps, Gery J.A. Bioul, Gustavo D. Sutter, Wiley. (ISBN- 978-0-47168783-2) | 2006 |
| 4 | Rapid Prototyping of Digital Systems, By James O. Hamblen, Tyson S. Hall,MichaelD.Furman,Springer.(ISBN:978-0-387-28965-6) | 2006 |
| 5 | Embedded systems Architecture programming and design-Rajkamal, 2nd edition,TataMcGrewHill(ISBN10: 0070667640 / ISBN13: 9780070667648) | 2008 |

# SEVENTH SEMESTER

## DEPARTMENT ELECTIVE COURSE-4,5

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Social Networks** | **L** | **T** | **P** | **None** |
| | **3** | **0** | **2** | |

**Course Objective:** To analyze and interpret social network structures and dynamics for practical and theoretical applications.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | To analyze and interpret various social network structures and metrics, such as centrality, density, and clustering |
| **CO2** | gain proficiency in using software tools and techniques for social network analysis, including data collection, visualization, and interpretation |
| **CO3** | Understand how social networks evolve over time and be able to assess the impact of network dynamics on information flow and social behavior |
| **CO4** | To apply social network analysis insights to solve practical problems in fields such as marketing, organizational behavior, and social sciences |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Graphs, Social Networks, Network Types, Network Data Sets, Gephi for Network Analysis. Network Properties: Network Measures, Strong and Weak Ties, Homophily, Structural Balance, and Components | **10** |
| **UNIT 2** | Network Models: Random Networks, Scale Free Networks, The Barabási-Albert Model, Erdos-Renyi Model, Structural Analysis of Networks using Python: Python for Network Analysis, Empirical Studies, Structural, Properties, Generate Synthetic Networks, Working with signed networks | **10** |
| **UNIT 3** | Social Network Applications: Information Cascades, Small-World Phenomenon, Epidemics, Community Detection, Link Prediction, and Page Rank | **14** |
| **UNIT 4** | Evolving Network and Temporal Networks: Network evolution, working with Temporal Network Data, Multiplex and Multi-layer network, Network Analysis in Other Fields: Network Analysis in Biology, Sports, Transports, etc. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Networks, Crowds, and Markets: Reasoning about a Highly Connected World by David Easley and Jon Kleinberg, Cambridge University Press | 2010 |
| **2** | Network Science by Albert-László Barabási, **Cambridge University Press** | 2016 |
| **3** | Networks by Mark Newman, OUP Oxford | 2018 |

| | | |
|---|---|---|
| **4** | The Structure of Complex Networks: Theory and Applications by Ernesto Estrada, OUP Oxford | 2011 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Intrusion Detection and Information Warfare** | **L** | **T** | **P** | Computer Networks, Information Security |
| | **3** | **1** | | |

**Course Objective:**To equip the students with knowledge about detection and prevention of various intrusions.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Students will be introduced to basic concepts of intrusion detection system. |
| **CO2** | Students will be able to understand Intrusion Prevention Systems, Network IDs protocol and model for intrusion analysis. |
| **CO3** | To Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems. |
| **CO4** | To Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction: Introduction to Intrusion Detection and Snort, Network Traffic Analysis Working with Snort Rules, Plugins, Preprocessors and Output Modules, Using Snort with MySQL, Using ACID and Snort Snarf with Snort, Miscellaneous Tools, Intrusion Prevention. | **10** |
| **UNIT 2** | Intrusion detection techniques: techniques to provide privacy in Internet Application and protecting digital contents (music, video, software) from unintended use, authentication. | **8** |
| **UNIT 3** | System and Application Security- mail security (PGP etc) file System security, program and security, memory security, Sandboxing. | **8** |
| **UNIT 4** | Security threads protection intruders: Viruses-trusted system. Secure programming languages- concepts structured multiprogramming, shared classes, cooperating sequential processes, structure of the multiprogramming system RC-4000 software. Information Warfare: offensive information warfare, defensive information warfare. | **8** |

| | | |
|---|---|---|
| **UNIT 5** | Key management in Group communication systems, Router security, Denial of service and side-channel attacks, Intrusion detection systems, Intrusion detection techniques-centralized and distributed. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Computer Security, Dicter gouman, John Wiley & Sons, 2014 | 2014 |
| **2** | Introduction to computer Security- Mathew Bishop, Addison-Wisley, 2004 | 2004 |
| **3** | Network Security – Private Communication in a Public World, 2nd edition, by C Kaufman, R. Pearlman, M. Speciner, Prentice Hall, 2002 | 2002 |
| 4 | Network security, Kaufman, Perlman and Speciner, Pearson Education, 2012 | 2012 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **High Performance Computing** | **L** | **T** | **P** | Operating systems, Algorithm Design and Analysis |
| | **3** | **2** | **0** | |

**Course Objective:** To understand design and application of advanced computer architectures and parallel algorithms to achieve high performance computing

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand basic concepts, advanced computer architectures, parallel algorithms |
| **CO2** | Apply priciples of Memory Hierarchies, Multi core Processors |
| **CO3** | Parallel Programming involving Revealing concurrency |
| **CO4** | Compare high performance methods with Achieving Measuring performance |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to advanced computer architectures, parallel algorithms, parallel languages, and performance oriented computing, discussing about the key characteristics of highend computing architectures. | **8** |

| | | |
|---|---|---|
| **UNIT 2** | Introduction to Computational Science and Engineering Applications, their characteristics and requirements,Review of Computational Complexity, Performance: metrics and measurements, Granularity and Partitioning, emporal/spatial/stream/kernel, Basic methods for parallel programming, Real-world case studies which are drawn from multiscale, multidiscipline applications. | **8** |
| **UNIT 3** | Memory Hierarchies, Multi core Processors, Homogeneous and Heterogeneous, Sharedmemory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators/ Reconfigurable Computing, Novel computers: Stream, multithreaded, and purposebuilt | **9** |
| **UNIT 4** | Parallel Programming involving Revealing concurrency in applications, Task and Functional parallelism, Task Scheduling, Synchronization Methods, Parallel Primitives (collective operations), SPMD Programming (threads, OpenMP, MPI), I/O and File Systems, Parallel Matlabs (Parallel Matlab, StarP, Matlab MPI) Partitioning Global Address Space (PGAS) languages (UPC, Titanium, Global Arrays). | **9** |
| **UNIT 5** | Discussion about high performance methods with Achieving Measuring performance, Identifying performance bottlenecks, Restructuring applications for deep memory hierarchies, Partitioning applications for heterogeneous resources, Using existing libraries, tools, and framework. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
|---|---|---|
| **1** | Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, AddisonWelsey | 2021 |
| **2** | Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series | 2018 |
| **3** | Chuck helebuyck, Programming PIC microcontrollers with PIC basic. | 2004 |
| 4 | Grama, A. Gupta, G. Karypis, V. Kumar, An Introduction to Parallel Computing, Design and Analysis of Algorithms: 2/e, AddisonWesley,2003 | 2012 |

| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
|---|---|---|---|---|
| **High Speed Networks** | **L** | **T** | **P** | Computer Networks |
| | **3** | **1** | **0** | |

**Course Objective:** To understand design and application of architechture and protocols of high speed computer networks

| **S. NO** | **Course Outcomes (CO)** |
|---|---|

| | |
|---|---|
| **CO1** | Understand concept of High Speed networks with Asynchronous transfer mode |
| **CO2** | Comprehend various Congestion And Traffic Management algorithms and Queuing Analysis- |
| **CO3** | Compare Integrated and differentiated network services |
| **CO4** | Learn Internetworking and Inter-domain Routing, |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | High Speed networks: Asynchronous transfer mode – ATM Protocol Architecture,ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs:Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications,requirements –Architecture of 802.11 | **9** |
| **UNIT 2** | Congestion And Traffic Management: Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion –Congestion Control – Traffic Management – Congestion Control in Packet SwitchingNetworks | **8** |
| **UNIT 3** | TCP And ATM Congestion Control : TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance ofTCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes –Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR ratecontrol, RM cell formats, ABR Capacity allocations – GFR traffic management | **8** |
| **UNIT 4** | Integrated and differential services integrated services architecture - approach, components, servicesqueuing discipline, fq, ps, brfq, gps, wfq - random early detection, differentiated services | **8** |
| **UNIT 5** | Protocols for qos support rsvp - goals & characteristics, data flow, rsvp operations, protocol mechanisms - multiprotocol label switching - operations, label stacking, protocol details - rtp - protocol architecture, data transfer protocol, rtcp. | **9** |
| **UNIT 6** | Internetworking: Inter-domain Routing, BGP, IPv6, Multicast Routing Protocols, Applications and Other Networking Technologies: RTP, RTSP, SIP, VoIP, Security Systems, SSH, PGP, TLS, IPSEC, DDoS AttackStacking, Protocol details - RTP - Protocol Architecture, Data Transfer Protocol, RTCP. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | HIGH SPEED NETWORKS AND INTERNET, 2nd edition, 2002 by William Stallings, Pearson Education, (ISBN-13: 9788177585698) | 2002 |
| **2** | HIGH PERFORMANCE COMMUNICATION NETWORKS, by Warland & Pravin Varaiya, Jean Hardcourt Asia Pvt. Ltd (ISBN-978-1-55860-574-9) | 2001 |
| **3** | MPLS and VPN architecture by Irvan Pepelnjk,Jin Guichard and Jeff Apcar, Cisco Press, Volume 1 and 2 (ISBN-13: 061-9472143230) | 2003 |
| **4** | Behrouz A. Forouzan, Data Communications and Networking, Fourth Ed., Tata McGraw Hill, (ISBN-0072967757) | 2007 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Information Security and Audit** | **L** | **T** | **P** | Networking |
| | **3** | **0** | **2** | |

**Course Objective:** To understand the risk assessment while handling and processing information and implementing security in audit. To discovery knowledge in collecting data about organization. To do various analysis on Information Risk Assessment.To understand IT audit and its activities.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand risk assessment in information handling and processing. |
| **CO2** | Implement security in auditing. |
| **CO3** | Acquire knowledge in data collection about organizations. |
| **CO4** | Perform various analyses on information risk assessment. Comprehend IT auditing and its activities. |

| **S. NO** | **Contents** | **Contact** |
|---|---|---|
| **UNIT 1** | Conventional Encryption Principles & Algorithms (DES, AFS, RC4, Blowfish), Block Cipher Modes of Operation, Location of Encryption Devices. Key Distribution. Public key cryptography principles, public key cryptography algorithms (RSA, Diffie-Hellman, ECC), public Key Distribution. | **8** |
| **UNIT 2** | Secure Hash Functions (SHA-512, MDS) and HMAC, Digital Signatures, Kerberos, X.509 Directory Authentication Service, Email Security: Pretty Good Privacy (PGP) IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining SecurityAssociations and Key Management. | **9** |
| **UNIT 3** | Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Firewalls: Firewall Design principles, Trusted Systems, Intrusion Detection Systems. | **9** |

| | | |
|---|---|---|
| **UNIT 4** | Introduction, Basic Terms Related to Audits, Security audits, The Need for Security Audits in Organization, Organizational Roles and Responsibilities for Security Audit, Auditors Responsibility in Security Audits, Types Of Security Audits. | **8** |
| **UNIT 5** | Approaches to Audits, Technology Based Audits Vulnerability Scanning And Penetration Testing, Resistance to Security Audits, Phase in security audit, Security audit Engagement Costs and other aspects, Budgeting for security audits, Selecting external Security Consultants. Key Success factors for security audits. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of** |
| **1** | Information Systems Security, Nina Godbole, Wiley | 2008 |
| **2** | Principles of Information Security, Whitman, Thornson, | 2008 |
| **3** | Cryptography and Network Security, William Stallings, Fourth Edition | 2007 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Multimedia System Design** | **L** | **T** | **P** | Basic of Linear Algebra and Programming |
| | **3** | **1** | **0** | |

**Course Objective:** To study the concepts of multimedia data, algorithms and compression.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To describe Multimedia Information, Multimedia Objects and Multimedia in business and work. |
| **CO2** | To analyze Multimedia Building Blocks like Text, Sound MIDI, Digital Audio, audio file formats. |
| **CO3** | To apply Data Compression: Huffman Coding, Shannon Fano Algorithm. |
| **CO4** | To explain Speech Compression & Synthesis, Digital Audio concepts |
| **CO5** | To analyze Multiple monitors, bitmaps, Vector drawing. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia inbusiness and work. Convergence of Computer, Communication and EntertainmentProducts ,Stages of Multimedia Projects:Multimedia hardware, Memory & storage devices, Communication devices, Multimedia softwares, presentation tools, tools for object generations, video, sound, image capturing,authoring tools, card and page based authoring tools. | **8** |
| **UNIT 2** | Multimedia Building Blocks: Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment, Audio & Video Capture. | **6** |
| **UNIT 3** | Data Compression: Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding,Arithmetic Coding Higher Order Modeling. Finite Context Modeling, Dictionary basedCompression, Sliding Window Compression, LZ77, LZW compression, Compression,Compression ratio loss less & lossy compression. | **6** |
| **UNIT 4** | Speech Compression & Synthesis : Digital Audio concepts, Sampling Variables, Loss less compression of sound, lossy compression & silence compression. | **8** |
| **UNIT 5** | Images: Multiple monitors, bitmaps, Vector drawing, lossy graphic compression, image fileformats, animations, Images standards, JPEG Compression, Zigzag Coding | **8** |
| **UNIT6** | MultimediaDatabase. Content based retrieval for text and images, Video: Video representation, Colors,Video Compression, MPEG standards, MHEG Standard Video Streaming on net, VideoConferencing, Multimedia Broadcast Services, Indexing and retrieval of Video Database,recent developments in Multimedia. | **6** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Tay Vaughan “Multimedia, Making IT Work” Osborne McGraw Hill. (ISBN-10: 0072264527), 2014, 2010 | 2010 |
| **2** | Buford “Multimedia Systems” Addison Wesley (ISBN-13: 9780201532586), 2000 | 2000 |
| **3** | Agarwal & Tiwari “Multimedia Systems” Excel, 2002 | 2002 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Multimodal Data Processing** | **L** | **T** | **P** | Machine Learning |
| | **3** | **1** | **0** | |

**Course Objective::** To Understand the fundamentals of Multimodal data, text processing techniques and language models

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Identify and explain the idea of multimodal data processing along with its applications in text processing |
| **CO2** | Locate and describe various terminologies in Speech processing |
| **CO3** | Interpret and analyze different digital image and video processing approaches. |
| **CO4** | Demonstrate the need of Conventional multi-modal learning and co-learning. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction: Introduction to Multimodal data and applications, Multimodal Representation: two broad approaches, Joint and Coordinated. Challenges of multimodal data, Data collection & cleaning.<br>Text Processing: Text normalization, Lemmatization, Morphology, Sub word tokenization; Text processing and statistics: TFIDF, BM-25, Zipf's law, Hipf's law; Language models and smoothing techniques; Vector space models. | **8** |
| **UNIT 2** | Speech Processing: Speech production and perception, Acoustic and articulatory phonetics; Short- term analysis: Need and windowing, Energy, Zero-crossing rate, Autocorrelation function, Fourier transform, Spectrogram; Short-term synthesis: Overlap-add method; Cepstrum analysis: Basis and development, mel-cepstrum. | **6** |
| **UNIT 3** | Digital Image and Video Processing: Point processing, Neighborhood processing, Enhancement, Edge detection, Segmentation, Feature descriptors, Restoration, Morphological operations, Image transforms, Spatial and temporal data handling | **6** |
| **UNIT 4** | Multi-modal learning and associated challenges: Applications and challenges from fusing two or more modalities such as vision, language, audio, graphs, biomedical signals, Development of shallow and deep networks for multimodal learning. | **8** |
| **UNIT 5** | Multi-modal processing and learning with applications: Image captioning, visual questioning answering system, automatic commentary generation, cognitive state estimation, recommendation system. Other Modalities: Biomedical signals, and Conventional multi-modal learning, co-learning etc. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | R. C. Gonzalez, R. E. Woods, “Digital Image Processing”, Pearson, Prentice-Hall, 4th Edition | 2017 |
| **2** | R. Klette, “Concise Computer Vision: An Introduction into Theory and Algorithms”, Springer, Latest Edition | 2014 |
| **3** | L. R. Rabiner, R. W. Schafer, “Introduction to Digital Speech Processing”, Now Publishers Inc, Latest Edition | 2007 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Big Data Analysis** | **L** | **T** | **P** | Database Management system |
| | **3** | **0** | **2** | |

**Course Objective:** Mastering the process of mapping and knowlegde extraction from huge volumes of data.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | To learn about distributed file system. |
| **CO2** | To understand the working of Apache Hadoop ecosystem. |
| **CO3** | To underatand working and commands of Hdoop. |
| **CO4** | To study usgaes and design og Hbase concepts. |
| **CO5** | To apply big data analytics in real life problem solving . |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce. | **8** |
| **UNIT 2** | Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization. | **8** |
| **UNIT 3** | Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance. | **9** |

| | | |
|---|---|---|
| **UNIT 4** | HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper | **9** |
| **UNIT 5** | Data Analytics with R: Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | C. J. Date Introduction to Database Systems . 8th Ed. Publisher: Addison-Wesley; ISBN-10: 0321197844/ ISBN-13: 978-0321197849. | 2003 |
| **2** | R. A. Mata-Toledo and P. Cushman, Fundamentals of SQL Programming. Schaum's Outline Series. McGraw-Hill | 2000 |
| **3** | H. Garcia-Molina and et al. Prentice Hall, Database Systems the Complete Book; ISBN-10: 0131873253 / ISBN-13: 978- 013187325 | 2008 |
| **4** | R. Elmasri and S. Navathe, Fundamentals of Database Systems Addison-Wesley;ISBN-10: 0136086209/ISBN-13: 978-0136086208 | 2010 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Mobile and Digital Forensics** | **L** | **T** | **P** | Malware Analysis |
| | **3** | **0** | **2** | |

**Course Objective:**Become knowlageble in mobile phone forensics and android forensics

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | The use of mobile phones and digital devices across the globe has increased dramatically |
| **CO2** | These devices are more suspectible to information security attacks |
| **CO3** | Thus they also posses huge evidences which shall be used during crime scene investigation |
| **CO4** | This course on mobile and digital forensics will provide a better understanding for these course participants on different forms of evidences in many digital devices,collections and interpretation of the same. |

| S. NO | Contents | Hours |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | Overview of wireless technologies and Security: Personal Area networks,Wireless Local Area Networks, Metropolitan Area Networks,Wide Area Networks. | **4** |
| **UNIT 2** | Wireless threats, Vulnerabilities and Security: Wireless LANs,War Driving,War Chalking,War Flying,Common Wi-fi security recommendations,PDA Security,Cell phones and Security,Wireless DoS attacks,GPS Jamming, Identity theft. | **8** |
| **UNIT 3** | CIA triad in mobile phones-Voice, SMS and Identification data interception in GSM: Introduction, practical setup and tools, implementation- Software and Hardware Mobile phone tricks: Netmonitor, GSM network service codes, mobile phone codes, catalog tricks and AT command set- SMS security issues | **10** |
| **UNIT 4** | Mobile phone forensics: crime and mobile phones, evidences, forensic procedures, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems- Android forensics: Procedures for handling an android device, imaging android USB mass storage devices, logical and physical techniques10 | **10** |
| **UNIT 5** | Digital forensics: Introduction – Evidential potential of digital devices: closed vs. open systems, evaluating digital evidence potential- Device handling: seizure | **10** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Iosif I.Androulidakis,"Mobile Phone security and forensics: A practical approach", Spriinger publications, ISBN 978-3-319-29742-2 | 2012 |
| **2** | Gregory Kipper, "Wireless Crime and Forensic Investigation",Auerbach publications | 2007 |
| **3** | Andrew Hoog,"Android Forensics:Investigation,Analysis and Mobile Security for google Android",Elsevier publications. | 2011 |
| **4** | Angus M.Marshall,"Digital forensics:Digital evidence in criminal investigations", John- Wiley and Sons. | 2008 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Soft Computing** | **L** | **T** | **P** | Probability and statistics, Machine learning |
| | **3** | **1** | **0** | |

**Course Objective:** 1. To design fuzzy systems for real-world problems using fuzzy logic and fuzzy sets.
2. To design and describe the architecture and functioning of neural networks and neuro-fuzzy systems.
3. To describe various evolutionary algorithms with application to real-worls optimization problems.

| S. NO. | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to distinguish between supervised, unsupervised and reinforcement learning. |
| **CO2** | Ability to construct a neural network architecture and describe its functioning mathematically. |
| **CO3** | Ability to execute operations with fuzzy sets and construct fuzzy rules. |
| **CO4** | Ability to solve simple problems involving fuzzy arithmetic and fuzzy numbers. |
| **CO5** | Ability to explain and compare different evolutionary algorithms. |
| **CO6** | Ability to construct the architecture and describe the functioning of neuro-fuzzy systems for simple application problems. |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Neural Networks:** Introduction to Learning Paradigms-Supervised, Unsupervised and reinforcement Learning. History of neural networks, overview of biological Neuro-systems, Mathematical Models of Neurons, ANN architecture and training algorithms- Perceptron, Multi-Layer Perceptron Model, Back Propagation algorithm, Applications of Artificial Neural | **12** |
| **UNIT 2** | **Fuzzy Logic:** Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. | **6** |
| **UNIT 3** | **Operations on Fuzzy Sets:** Complement, Intersections, Unions, Combinations of Operations, Aggregation Operations. Nonspecificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets. Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. | **8** |
| **UNIT 4** | **Evolutionary Optimization:** Introduction to evolutionary optimization algorithms - Genetic Algorithm, Particle Swarm Optimization, Grey Wolf Optimization, Artificial bee colony algorithm. Comparison to classical optimization using gradient descent and Meta-heuristic optimization algorithm - Simulated annealing. | **10** |
| **UNIT 5** | **Neuro-Fuzzy Systems:** Adaptive neuro-fuzzy inference systems - ANFIS, CANFIS, MANFIS. Architecture and learning process, Examples of application to real-world problems. | **6** |

| | TOTAL | 42 |
|---|---|---|

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Jang, Sun, Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Pearson Education India. | 2015 |
| **2** | G.J. Klir & B. Yuan, “Fuzzy Sets & Fuzzy Logic”, PHI. | 2009 |
| **3** | T.J. Ross, "Fuzzy Logic with Engineering Applications", 3ed, Wiley. | 2011 |
| **4** | S. Rajasekaran & G. A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI. | 2003 |
| **5** | S. V. Kartalopoulos, “Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications", IEEE Press – PHI. | 1997 |
| **6** | S. Roy, U. Chakraborty, "Soft Computing", Pearson India. | 2013 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Augmented Reality & Virtual Reality** | **L** | **T** | **P** | Programming, Problem Solving, Engineering Graphics |
| | **3** | **1** | **-** | |

**Course Objective:**

1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction techniques related to VR/AR
2. Review the Geometric Modeling Techniques in AR/VR
3. Discuss the Virtual Environment and Examine VR/AR Technologies
4. Use of various types of Hardware and Software in Virtual Reality systems
6. Simulate and Apply Virtual/Augmented Reality to varieties of Applications

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental Computer Vision, Computer Graphics and Human Computer Interaction Techniques related to VR/AR |
| **CO2** | Learn Geometric Modeling Techniques and its Virtual Environment. |
| **CO3** | Analyze and Evaluate the VR/AR Technologies. |
| **CO4** | Apply various types of hardware and software in Virtual Reality systems and formulate AR/VR applications. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | **Introduction to Virtual Reality (VR):** Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics,<br>Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark | 8 |
| UNIT 2 | **Virtual Environment:** Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Videobased Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)<br>**Generic VR system:** Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, **Animating the Virtual Environment:** Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system<br>**Physical Simulation:** Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft | 12 |
| UNIT 3 | **Augmented Reality (AR):** Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems | 8 |
| UNIT 4 | **Development Tools and Frameworks Human factors:** Introduction, the eye, the ear, the somatic senses<br>**Hardware:** Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems<br>**Software:** Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML<br>**AR / VR Applications:** Introduction, Engineering, Entertainment, Science, Training, Game Development | 6 |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | Craig, A. B., "Understanding Augmented Reality, Concepts and Applications," Morgan Kaufmann, ISBN: 9780240824086 | 2013 |
| 2 | Craig, A. B., Sherman, W. R., Will, J. D., "Developing Virtual Reality Applications, Foundations of Effective Design," Morgan Kaufmann | 2009 |
| 3 | John Vince, J., (2002), "Virtual Reality Systems, " Pearson, ISBN: 9788131708446 | 2002 |
| 4 | Anand, R., "Augmented and Virtual Reality," Khanna Publishing House | 2022 |

| | | |
|---|---|---|
| 5 | Kim, G. J., (2005), "Designing Virtual Systems: The Structured Approach", ISBN: 9781852339586 | 2005 |
| 6 | John Vince, "Virtual Reality Systems", Pearson Ed | 2002 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Enterprise Java Programming** | **L** | **T** | **P** | Core JAVA |
| | **3** | **1** | **0** | |

**Course Objective:** To familiarize students with advanced JAVA programming constructs.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | To introduce fundamentals of Enterprise Java Programming, |
| **CO2** | To implement interfaces, collections |
| **CO3** | To implement TCP/IP programming |
| **CO4** | To learn database Connectivity |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Interfaces, packages, Collections : Collection Interfaces, Concrete Collections, Collections Framework. | **8** |
| **UNIT 2** | Multithreading : Creating and running thread, Multiple thread synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle ofThread. | **8** |
| **UNIT 3** | Fundamentals in Networking: Sockets in Java - Internet Addressing -DNS – Ipv4,IPv6- URL class - TCP/IP and Datagram. The interfaces and classes for networking :Interfaces and classes of java.net package; InetAddress class : IP address scope - Host name resolution - Methods of InetAddress class; Program to look up the IP addresses for a hostname - Factory methods - Creating and using Sockets : Socket class - constructors and methods of Socket class. Creating TCP servers &clients : TCP/IP server sockets - Constructors and methods of ServerSocket class - Program to create a TCP/IP server and client. | **8** |
| **UNIT 4** | Handling URL: URL class - constructors and methods of URL class - URLConnection class - fields of URLConnection class - methods of URLConnection class. Working with Datagrams: DatagramPacket - Constructors for DatagramPacket class - Methods of DatagramPacket class - creating Datagram server and client | **8** |

| | | |
|---|---|---|
| **UNIT 5** | JDBC Package :JDBC – JDBC versus ODBC – Types of JDBC drivers – Connection – Statement – PreparedStatement.ResultSet :Fields of ResultSet – Methods of ResultSet – Executing a query - ResultSetMetaData – DatabaseMetaData. Datatypes in JDBC : Basic datatypes in JDBC – Advanced datatypes in JDBC – fields of Statement – methods of Statement – CallableStatement Interface – BatchUpdates | **10** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Java 2 Programming Black Book - Steven Holzner dreamTech Press(ISBN9788177226553) | 2005 |
| **2** | Head first EJB-O'Reilly (ISBN: 8173665265) | 2003 |
| **3** | "Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional" by Antonio Goncalves– Apress publication(ISBN: 9781430219545) | 2009 |

## GENERIC ELECTIVE COURSE-3

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Introduction to Cyber Physical Systems** | **L** | **T** | **P** | Programming languages, operating systems, and computer networks. |
| | **3** | **1** | **0** | |

**Course Objective:** 1)To provide students with a fundamental understanding of Cyber-Physical Systems (CPS), their components, and applications across various domains.
2)To develop the ability to model and analyze physical and cyber components in CPS using mathematical and computational tools.
3)To impart knowledge on networking and communication protocols specific to CPS, with an emphasis on time synchronization, scheduling, and security.
4)To equip students with the skills to design and implement CPS using embedded platforms, real-time operating systems, and hardware-software co-design methodologies.
5)To explore advanced topics in CPS, including the integration of IoT, machine learning, and emerging trends in security, privacy, and industry applications.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand and apply secure coding principles in software development. |
| **CO2** | Model and analyze the behavior of physical and cyber components in CPS using appropriate mathematical and computational techniques. |

| | |
|---|---|
| **CO3** | Apply networking and communication protocols specific to CPS, with the ability to address issues related to time synchronization, scheduling, and security. |
| **CO4** | Design and implement CPS solutions using embedded platforms, considering real-time constraints, hardware-software co-design, and practical case studies. |
| **CO5** | Analyze advanced CPS topics, including the integration of IoT, machine learning, and security strategies, while understanding future trends in CPS development. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to Cyber-Physical Systems**<br>Definition and Evolution of CPS<br>Difference between Embedded Systems and CPS<br>Components of CPS: Sensors, Actuators, Networks, and Computing Units<br>Applications of CPS in Various Domains: Automotive, Healthcare, Smart Grid, Industrial Automation<br>Challenges in CPS: Security, Real-Time Constraints, Heterogeneity, Scalability | **10** |
| **UNIT 2** | **Modeling and Analysis of CPS**<br>Modeling of Physical Systems: Differential Equations, State-Space Models<br>Cyber-Physical System Modeling: Hybrid Automata, Petri Nets, and State Machines<br>Control System Basics for CPS: Feedback, Stability, and Control Laws<br>Simulation Tools for CPS: MATLAB/Simulink, Modelica | **12** |
| **UNIT 3** | **Networking and Communication in CPS**<br>Communication Protocols for CPS: ZigBee, Bluetooth, Wi-Fi, 6LoWPAN<br>Time Synchronization and Scheduling in CPS<br>Networked Control Systems: Architecture, Challenges, and Protocols<br>Security in CPS Communication: Cryptography, Authentication, and Integrity | **10** |
| **UNIT 4** | **CPS Design and Implementation**<br>CPS Design Methodology: Co-Design of Hardware and Software<br>Real-Time Operating Systems (RTOS) for CPS<br>Implementation of CPS using Embedded Platforms: Raspberry Pi, Arduino, and FPGA<br>Case Studies: Autonomous Vehicles, Smart Homes, and Industrial Automation | **10** |
| **UNIT 5** | **Advanced Topics in CPS**<br>Machine Learning in CPS: Techniques and Applications<br>Internet of Things (IoT) and CPS Integration<br>Security and Privacy Issues in CPS: Threats, Attack Models, and Mitigation Strategies<br>Future Trends in CPS: Edge Computing, AI-Driven CPS, and Industry 4.0 | **10** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | Song, H., Rawat, D. B., Jeschke, S., & Brecher, C. Cyber-Physical Systems: Foundations, Principles and Applications (2nd ed.). Academic Press. | 2023 |
| 2 | Alur, R. Principles of Cyber-Physical Systems (2nd ed.). MIT Press. ISBN: 978-0262045955. | 2022 |
| 3 | Lee, E. A., & Seshia, S. A. Introduction to Embedded Systems: A Cyber-Physical Systems Approach (2nd ed.). MIT Press. ISBN: 978-0262538808. | 2022 |
| 4 | Groote, J. F., & Mousavi, M. R. Modeling and Analysis of Communicating Systems (3rd ed.). MIT Press. ISBN: 978-0262538051. | 2021 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Data Warehousing and Data Mining** | **L** | **T** | **P** | Database Management Systems |
| | **3** | **0** | **2** | |

**Course Objective:**To introduce the concept of Data Warehousing and Data Mining, respective techniques and applications in real world scenario.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Identify the scope and necessity of Data Mining & Warehousing for the society |
| **CO2** | To understand various tools of Data Mining and their techniques to solve the real time problems. |
| **CO3** | To develop ability to design various algorithms based on data mining tools. |
| **CO4** | To develop further interest in research and design of new Data Mining techniques. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Data Warehousing: - Basic concepts in data warehousing, Collecting the requirements of data warehouse, Data Warehouse Architecture, Design, Implementation & Maintenance, OLAP in data warehouse, Data warehousing and the web, Data Cube Technology, From Data Warehousing to Data Mining. | **10** |

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|---|---|---|
| **UNIT 2** | Mining Association Rules in Large Databases: Association Rule Mining, Mining Single Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint Based Association Mining. | **8** |
| **UNIT 3** | Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy. | **8** |
| **UNIT 4** | Cluster Analysis in Data Mining: Types of Data in Cluster Analysis. A Categorization of Major Clustering Methods, Partitioning Methods, Density Based Methods, Grid Based Methods; Model Based Clustering Methods, Outlier Analysis | **8** |
| **UNIT 5** | Mining Complex Types of Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time Series and Sequence Data, Mining Text Databases. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Data Warehousing Fundamentals, P. Ponnian, John Wiley | 2011 |
| **2** | Data Mining Introductory & Advanced Topics, M.H. Dunham, Pearson Education | 2012 |
| **3** | Data Mining Concepts & Techniques, Han Kamber, M. Kaufman, 2nd ed, | 2011 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Game Theory** | **L** | **T** | **P** | Mathematical Foundations, Discrete Mathematics. |
| | **3** | **1** | **0** | |

**Course Objective:** 1)To provide students with a solid foundation in the principles and concepts of game theory.
2)To equip students with the ability to model and analyze strategic interactions in various fields using game theory.
3)To introduce students to different types of games, including strategic form, extensive form, and cooperative games, and their applications.
4)To explore advanced topics in game theory, including evolutionary game theory, mechanism design, and network games.
5)To develop critical thinking skills that enable students to apply game theory to real-world problems in economics, computer science, and engineering.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand and apply the fundamental concepts and tools of game theory in strategic decision-making. |
| **CO2** | Model and analyze various types of games, including strategic form, extensive form, and cooperative games. |
| **CO3** | Compute and interpret Nash equilibria, subgame perfect equilibria, and other solution concepts in game theory. |
| **CO4** | Apply game theory to real-world scenarios, including economic competition, bargaining, auctions, and network design. |
| **CO5** | Explore and engage with advanced topics in game theory, preparing for further research or application in related fields. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to Game Theory**<br>Overview of Game Theory: Definitions and Scope<br>Types of Games: Cooperative vs. Non-Cooperative, Symmetric vs. Asymmetric, Zero-Sum vs. Non-Zero-Sum<br>Basic Concepts: Players, Strategies, Payoffs, and Equilibrium<br>The Concept of Nash Equilibrium: Definition, Examples, and Applications<br>Dominant and Dominated Strategies, Best Response Functions | **8** |
| **UNIT 2** | **Strategic Form Games and Mixed Strategy Equilibria**<br>Strategic Form Representation of Games<br>Pure Strategy Nash Equilibrium: Existence and Computation<br>Mixed Strategy Nash Equilibrium: Concept, Computation, and Examples<br>Applications of Mixed Strategy Equilibria in Real-World Scenarios<br>Introduction to Bayesian Games: Incomplete Information and Bayesian Equilibrium | **8** |

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|---|---|---|
| **UNIT 3** | **Extensive Form Games and Repeated Games**<br>Extensive Form Representation of Games: Game Trees, Information Sets, and Strategies<br>Subgame Perfect Equilibrium: Concept, Computation, and Examples<br>Introduction to Repeated Games: Finite and Infinite Horizon<br>The Folk Theorem and its Implications for Cooperation in Repeated Games<br>Case Studies: Applications of Repeated Games in Economics and Computer | **9** |
| **UNIT 4** | **Cooperative Game Theory**<br>Introduction to Cooperative Games: Coalition Formation and Payoff Distribution<br>The Core: Definition, Properties, and Computation<br>The Shapley Value: Concept, Calculation, and Applications<br>Bargaining Games: Nash Bargaining Solution and Applications<br>Applications of Cooperative Game Theory in Economics, Politics, and Network Design | **9** |
| **UNIT 5** | **Advanced Topics in Game Theory**<br>Evolutionary Game Theory: Concepts, Replicator Dynamics, and Evolutionarily Stable Strategies<br>Mechanism Design: Incentives, Implementation, and Revelation Principle<br>Auctions and Bidding Strategies: First-Price, Second-Price, English, and Dutch Auctions<br>Network Games: Strategic Interactions on Graphs and Network Formation<br>Current Trends and Research Directions in Game Theory | **8** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Osborne, M. J., & Rubinstein, A. (2020). A Course in Game Theory. MIT Press. ISBN: 978-0262650403. | 2020 |
| **2** | Tadelis, S. (2019). Game Theory: An Introduction (2nd ed.). Princeton University Press. ISBN: 978-0691169064. | 2019 |
| **3** | Myerson, R. B. (2021). Game Theory: Analysis of Conflict. Harvard University Press. ISBN: 978-0674728626. | 2021 |
| **4** | Fudenberg, D., & Tirole, J. (2020). Game Theory. MIT Press. ISBN: 978-0262061414. | 2020 |
| **5** | Gibbons, R. (2019). A Primer in Game Theory. Pearson Education. ISBN: 978-1292026211. | 2019 |


| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Information Theory and Coding** | **L** | **T** | **P** | NIL |
| | **3** | **1** | **0** | |

**Course Objective:** This course provides a deep understanding of probability theory, information theory, and coding techniques, with practical applications in error control, channel coding, and advanced methods like convolution and turbo codes.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Develop a understanding of probability theory, including key theorems and concepts, to model and analyze random phenomena. |
| **CO2** | Explore insights into information theory by studying entropy, mutual information, and coding techniques, enabling efficient data compression and transmission. |
| **CO3** | Understand the principles of error control coding and channel capacity, applying them to design reliable communication systems. |
| **CO4** | Explore advanced coding strategies, such as cyclic and convolutional codes, and apply optimization techniques to solve complex communication problems. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Probability, Sample space and events, The axioms of probability Elementary theorems -Conditional Probability and Independence, Baye's theorem. Random variables, discrete probability distribution, discrete functions for random and discrete random variables, continuous random variables. | **6** |
| **UNIT 2** | Uncertainty and Information, Shannon Entropy, Joint and conditional Entropies Mutual Information, Uniquely decipherable and Instantaneous codes, Noiseless coding problem. Source coding Theorem, Block coding, construction of Optimal codes, Huffman's & Shannon – Fano methods. | **8** |
| **UNIT 3** | Discrete memory less channel, channel capacity BSC and other channels | **6** |
| **UNIT 4** | Information measure for continuous ensembles capacity of AWGN channel. Error control coding. The channel coding Theorem, Application to BSC , Source Coding with fidelity criteria. Types of codes, error and error control strategies, Linear block codes, syndrome and error detection, Minimum distance, Error detecting and correcting capabilities of a block code, Syndrome decoding , Hamming codes. | **8** |
| **UNIT 5** | Cyclic codes, Generator and parity – check matrices, encoding, syndrome computation, error detection and decoding.BCH codes, decoding, of the BCH codes Introduction to RS codes. Convolution codes, Maximum likelihood decoding The Viterbi algorithm. Introduction to Turbo codes. | **8** |
| **UNIT 6** | Blind Deconvolution Using Convex Programming, Asynchronous code-division random access using convex optimization. | **6** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | Information Theory by R Ash, Dover Science Publications | 1990 |
| 2 | Element of Information Theory by Cover and Thomas, John Wiley & Sons | 2006 |
| 3 | Error Control coding: Fundamental & Application by Shulin & Daniel J. Costello Jr, Prentice Hall | 2004 |
| 4 | A Mathematical Theory of Communication. By C. E. SHANNON. | 1948 |
| 5 | Communication Systems By Simon Haykin, Wiley Student Edition | 2009 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Pattern Recognition and Applications** | **L** | **T** | **P** | Linear Algebra, Probability Theory |
| | **3** | **0** | **2** | |

**Course Objective:** Understand pattern recognition theories and apply them in practical problems.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Summarize the various techniques involved in pattern recognition |
| **CO2** | Categorize the various pattern recognition techniques into supervised and unsupervised. |
| **CO3** | Illustrate the artificial neural network based pattern recognition |
| **CO4** | Discuss the applications of pattern recognition in various real life problems |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Fundamental concepts and blocks of a typical pattern recognition system. Decision functions- role and types, pattern and weight space, properties and implementation of decision functions. | **10** |
| **UNIT 2** | Feature identification, selection and extraction. Distance measures, clustering transformation and feature ordering, clustering in feature selection, feature selection through maximization and approximations. | **8** |

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|---|---|---|
| **UNIT 3** | Pattern classification by distance functions. Clusters and cluster seeking algorithms. Pattern classification by likelihood functions. Baye's classifier and performance measures. | **8** |
| **UNIT 4** | Artificial neural network model, Neural network-based pattern associators, Feed forward networks and training by back-propagation- ART networks. | **8** |
| **UNIT 5** | Applications of statistical and neural network – based pattern classifiers in speech recognition, image recognition and target recognition. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | R. O. Duda, P. Hart, D. Stork, Pattern Classification, 2nd Ed. Wiley, ISBN: 978 0-471-05669-0. | 2000 |
| **2** | Bishop, C. M., Pattern Recognition and Machine Learning. Springer, ISBN 978-0-387-31073-2 | 2007 |
| **3** | Bishop, C. M., Neural Networks for Pattern Recognition, Oxford University Press, ISBN-13: 978-0198538646 | 1995 |
| **4** | Theodoridis, S. and Koutroumbas, K., Pattern Recognition, 4th Ed. Academic Press,SBN :9781597492720 | 2008 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Grid and Cluster Computing** | **L** | **T** | **P** | Computer Networks |
| | **3** | **1** | **0** | |

**Course Objective:** To understand concepts of Cluster based distributed computing and associated Hardware technologies

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand concepts in Cluster based distributed computing Hardware technologies |
| **CO2** | Learn Programming Models and Paradigms |
| **CO3** | Compare Grid Computing: Grids and Grid Technologies, Programming models and Parallelization Techniques |
| **CO4** | Study Data Management Application |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Cluster Computing Introduction to concepts in Cluster based distributed computing Hardware technologies for cluster computing and software for cluster computing, and different Software Architecture for Cluster Computing. | **8** |
| **UNIT 2** | Programming; Programming Models and Paradigms, features and performance of standard MPI variants, Derived data types, communicators. | **9** |
| **UNIT 3** | Resource management and scheduling Managing, cluster resources: single system images, system level middleware, distributed task scheduling, monitoring and administering system resources Parallel I/O and Parallel Virtual File System. Scheduling: Condor, Maui Scheduler, Portable Batch System (PBS). | **9** |
| **UNIT 4** | Grid Computing: Grids and Grid Technologies, Programming models and Parallelization Techniques, Grid Security Infrastructure, Setting up Grid, deployment of Grid software and tools, and application execution | **8** |
| **UNIT 5** | Standard application development tools and paradigms Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf.message | **8** |
| **UNIT 6** | Data Management Application Case Study: Molecular Modeling for Drug Design and Brain Activity Analysis, Resource management and scheduling. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Grid and Cluster Computing by C.S.R. Prabhu, PHI, 2008 | 2008 |
| **2** | Introduction to grid computing - Bart Jacob, Michael Brown, 2005 | 2005 |
| **3** | B.Wilkinson, Grid Computing: Techniques and Applications, CRC Press, 2009 | 2009 |
| **4** | R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson Education, 2008 | 2008 |

## EIGTH SEMESTER

**DEPARTMENT ELECTIVE COURSE-6**

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| | **L** | **T** | **P** | |
| **Speech & Natural language Understanding** | **3** | **1** | **0** | Probability and statistics, Machine learning |

**Course Objective:** 1. To familiarize with basic fundamentals of speech signals and text pre-processing for natural language understanding
2.To understand and implement feature extraction techniques for speech and text.
3. To understand, analyze and implement advanced techniques for natural language understanding using speech and text.

| S. NO. | Course Outcomes (CO) |
|---|---|
| **CO1** | Ability to understand and explain various terminology related to Speech and Natural Language Understanding. |
| **CO2** | Ability to implement text pre-processing and pattern matching using regular expressions. |
| **CO3** | Ability to analyze and classify text using Bag of words, word embeddings, and WordNet. |
| **CO4** | Ability to differentiate between types of phonemes, and conduct phonetic analysis of English words . |
| **CO5** | Ability to analyze speech waveforms and spectrograms, and describe the feature extraction process for speech recognition. |
| **CO6** | Ability to describe real-world applications of Speech and Natural Language Understanding. |

| S. NO. | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | **Introduction to natural language understanding using speech:** Introduction to Natural Language Understanding using speech signals. Characteristics of speech signals-pitch, energy, formants etc. Extraction, analysis and classification of speech-based features such as MFCC and spectrograms. Phonetics- phonemes, phonetic analysis of English words. | **12** |
| **UNIT 2** | **Introduction to natural language understanding using text**: Introduction to Natural Language Understanding using text. Pattern matching using regular expressions. Text pre-processing: Tokenization, Lemmatization, Stemming. Bag of Words, 1-hot encoding, TF, TF-IDF, N-gram language modelling, Word Embeddings. | **12** |
| **UNIT 3** | **Text-based semantics:** Word Senses, WordNet, Synsets, Hypernyms, Hyponyms, Meronyms, Holonyms, Word Sense Disambiguation, Word Similarity, Semantic Role Labelling. | **8** |

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|---|---|---|
| **UNIT 4** | **Advanced techniques:** Large Language Models, Deep learning models for speech and text, Machine Translation, Man-Machine Interfaces, Advanced speech recognition systems. | **10** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | D. Jurafsky, J. H. Martin, Speech and Language Processing, 2/e, Pearson Education. | 2013 |
| **2** | L. Rabiner, "Fundamentals of speech recognition", Prentice-Hall. | 1993 |
| **3** | S. Bird, E. Klein, E. Loper, "Natural Language Processing with Python", O'Reilly. | 2009 |
| **4** | Manning and Schutze, "Foundation of Statistical Natural Language Processing", MIT press. | 1999 |
| **5** | U. Kamath, J. Liu, J. Whitaker, "Deep learning for NLP and speech recognition", Springer. | 2019 |
| **6** | D. Rothman, "Transformers for Natural Language Processing", Packt publishing. | 2021 |

**B.Tech. Information Technology**

| Course code: Course Title | Course Structure | | | Pre-Requisite |
|---|---|---|---|---|
| | **L** | **T** | **P** | |
| **Ethical Hacking** | **3** | **1** | **0** | Information Security/ Malware Analysis |

**Course Objective:** This course aims to equip students with a comprehensive understanding of security and ethical hacking principles, including reconnaissance, scanning, and password cracking techniques. Students will learn to identify and address vulnerabilities in web applications and wireless networks, using practical tools and methodologies to enhance their ability to secure systems and applications.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand Security and Ethical Hacking: Grasp fundamental security principles, ethical hacking concepts, and key terminologies. |
| **CO2** | Conduct Reconnaissance and Scanning: Perform footprinting and port scanning using relevant tools. |

| | |
|---|---|
| **CO3** | Analyze Cracking and Sniffing Techniques: Understand password cracking methods and sniffing techniques. |
| **CO4** | Secure Web Applications and Wireless Networks: Identify vulnerabilities in web applications and secure wireless networks. |

| S. NO | Contents | Contact H... |
|---|---|---|
| **UNIT 1** | Understanding the importance of security, Concept of ethical hacking and essential TerminologiesThreat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking. | **9** |
| **UNIT 2** | Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers,Tools used for the reconnaissance phase.Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS. | **11** |
| **UNIT 3** | Aspect of remote password guessing, Role of eavesdropping ,Various methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. | **9** |
| **UNIT 4** | Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking,Types of Session Hijacking, Session Hijacking Tools. | **9** |
| **UNIT 5** | Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLANScanners, WLANSniffers, Hacking Tools, Securing Wireless Networks. | **4** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / |
|---|---|---|
| **1** | "Certified Ethical Hacker", Kimberly Graves, Wiley India Pvt Ltd ISBN 978-0-470-52520-3 | 2019 |
| **2** | "Network Seuciryt and Ethical Hacking", Rajat Khare, Luniver Press ISBN:978-1-905986-00-2 | 2006 |
| **3** | Thomas Mathew, "Ethical Hacking", OSB publishers ISBN: 0972936211 | 2003 |
| **4** | Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, ISBN: 9781849515580 | 2011 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| | **L** | **T** | **P** | Linear algebra, probability, |

| | | | | |
|---|---|---|---|---|
| **Quantum Computing** | **3** | **1** | **0** | complex numbers, Algorithms, data structure |

**Course Objective:** To familiarize students with the concepts of quantum computing.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand the Fundamental Principles of Quantum Mechanics and Computing |
| **CO2** | Develop Proficiency in Quantum Algorithms and Circuit Design |
| **CO3** | Explore Quantum Information Theory and Its Applications |
| **CO4** | Evaluate Quantum Hardware Technologies and Address Implementation Challenges |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Quantum Computing: Basics of Quantum Mechanics, Quantum states, superposition, and entanglement.<br>Quantum measurement and operators. Quantum Computation Overview<br>Comparison with classical computing. Quantum vs. classical bits (qubits).<br>Quantum Gates and Circuits<br>Quantum Gates : Single-qubit gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase, and T-gates. Multi-qubit gates: CNOT, Toffoli, SWAP.<br>Quantum Circuits | **10** |
| **UNIT 2** | Quantum Algorithms: Basic Algorithms<br>Deutsch-Josza algorithm. Grover's algorithm for unstructured search.<br>Shor's Algorithm, Quantum factorization and implications for cryptography.<br>Quantum Fourier Transform (QFT)<br>Applications in quantum algorithms. | **8** |
| **UNIT 3** | Quantum Information Theory: Quantum Entanglement<br>Bell states, EPR pairs, and teleportation.<br>Quantum Error Correction Error correction codes: Shor code, Steane code.<br>Quantum Cryptography Quantum key distribution (e.g., BB84 protocol). | **8** |
| **UNIT 4** | Quantum Simulation and Optimization<br>Quantum Simulators<br>Simulating quantum systems with quantum computers.<br>Quantum Optimization Algorithms<br>Variational Quantum Eigensolver (VQE), Quantum Approximate Optimization Algorithm (QAOA). | **8** |

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|---|---|---|
| **UNIT 5** | Practical Quantum Computing<br>Quantum Programming Languages<br>Qiskit, QuTiP, Cirq, and others.<br>Quantum Computing Frameworks<br>IBM Quantum Experience, Google Quantum AI, Microsoft Quantum Development Kit. | **8** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang (2000) | 2000 |
| **2** | Quantum Computing: An Applied Approach" by Jack D. Hidary (2021) | 2021 |
| **3** | Quantum Computation and Quantum Information: 10th Anniversary Edition" by Michael A. Nielsen and Isaac L. Chuang (2010) | 2010 |
| **4** | Quantum Computing: A Gentle Introduction" by Yasir A. Abbas (2021) | 2021 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **GPU Computing** | **L** | **T** | **P** | Computer Architecture |
| | **3** | **0** | **2** | |

**Course Objective:** This course aims to provide a solid understanding of GPU architecture and programming models like CUDA and OpenCL. Students will learn to develop GPU-accelerated applications, apply GPU computing to solve real-world problems, and evaluate the suitability of GPU computing for various computational tasks.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the fundamental concepts and architecture of GPUs. |
| **CO2** | Utilize GPU programming models (e.g., CUDA, OpenCL) to develop efficient GPU-accelerated applications. |
| **CO3** | Apply GPU computing techniques to solve real-world problems in various domains. |
| **CO4** | Evaluate the suitability of GPU computing for specific computational tasks. |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT 1** | **Introduction to GPU Computing:** GPU Architecture: Comparison with CPUs, CUDA Cores, SMs, and Memory Hierarchy, GPU Programming Models: CUDA and OpenCL, Basic Concepts and Syntax Parallel Programming Paradigms: Data Parallelism, Task Parallelism , Hybrid Parallelism | **8** |
| **UNIT 2** | **CUDA Programming**: CUDA Programming Fundamentals: Kernels and Device Functions, Memory Management (Host and Device Memory), Thread and Block Hierarchies, CUDA Performance Optimization:, Memory Coalescing, Shared Memory Optimization, Texture, Memory Utilization, Occupancy and Warp Divergence, CUDA Examples:, Matrix Multiplication, Image Processing, Monte Carlo Simulations | **9** |
| **UNIT 3** | **OpenCL Programming:** OpenCL Basics: OpenCL Runtime and Host API, OpenCL Kernels and Work Items, Memory Management (Host and Device Memory), OpenCL Performance Optimization:, Work Group and Work Item Scheduling, Data Transfer Optimization, Kernel, Optimization Techniques, OpenCL Examples:, Image Filtering, Molecular Dynamics Simulations, Scientific Computing Applications | **9** |
| **UNIT 4** | **Advanced GPU Topics:** GPU Heterogeneous Computing: CPU-GPU Integration, GPU-GPU Communication, GPU Libraries and Frameworks:, CUDA Toolkit, OpenCL Runtime, cuBLAS, cuFFT, cuDNN, GPU Programming Patterns:, Reduction Operations, Scan Operations, Sorting Algorithms, GPU Debugging and Profiling Tools | **8** |
| **UNIT 5** | **GPU Applications and Case Studies:** GPU Applications in Various Domains:, Machine Learning and Deep Learning, Computational Fluid Dynamics, Bioinformatics, Financial Modeling, Scientific Visualization, GPU Case Studies:, Real-world examples of GPU-accelerated applications, Performance analysis and benchmarking, Future Trends in GPU Computing | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | CUDA by Example: An Introduction to General-Purpose GPU Programming | 2010 |
| **2** | GPU Computing Gems Jade Edition | 2011 |
| **3** | Hands-On GPU Programming with Python and CUDA: Explore high-performance parallel computing with CUDA | 2018 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Autonomous Systems and** | **L** | **T** | **P** | |

| Robotics | 3 | 1 | 0 | |
|---|---|---|---|---|

**Course Objective:**To Understand significance of autonomus components and robotics

| S. NO | Course Outcomes (CO) |
|---|---|
| CO1 | Introduction to significance of autonomus components and robotics |
| CO2 | Study field transmitters |
| CO3 | Compare Final control elements and accessories: |
| CO4 | Understand Components of Industrial Robot |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | Overview: Introduction, significance of autonomus components, Industiral applications | 8 |
| UNIT 2 | Autonomus Systems and Robotics | 8 |
| UNIT 3 | Field Transmitters | 9 |
| UNIT 4 | Final control elements and accessories: Control valves, actuators, converters, vfd, safety valves | 9 |
| UNIT 5 | Auxiliary control components | 8 |
| UNIT 6 | Components of Industrial Robot | 8 |
| | TOTAL | 42 |

| REFERENCES | | |
|---|---|---|
| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
| 1 | Autonomous Systems: Theory and Applications, Reza Malekzadeh, Mohammadreza Abolhasani | 2023 |
| 2 | Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms, Nikolaus Correll, Bradley Hayes, David Coleman | 2024 |
| 3 | Modern Robotics: Mechanics, Planning, and Control, Kevin M. Lynch, Frank C. Park | 2022 |
| 4 | utonomous Vehicle Systems: Planning, Control, and Communication, Marko Bjelica, Silvio Giordano | 2023 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| Course code: Course Title | Course Structure | | | Pre-Requisite |
| Sementic Web and Web | L | T | P | Web Technologies |

| | | | | |
|---|---|---|---|---|
| **Mining** | **3** | **0** | **2** | Web Technologies |

**Course Objective:** Understand the concept structure of the semantic web technology and how this technology revolutionizes the World Wide Web. Understand the concepts of Web Science, semantics of knowledge and resource, ontology.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | To understand fundamentals of sementic web. |
| **CO2** | To study Knowledge Representation for the Semantic Web Ontologies. |
| **CO3** | To learn Web Ontology Engineering process. |
| **CO4** | To learn different application of sementic web. |
| **CO5** | To get infrormed with different web resources. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Semantic Web Introduction: fundamental of semantic web, Examples of semantic web, Semantic web technologies, layered approach Web Intelligence Thinking and Intelligent Web Applications, The World Wide Web, Limitations of Today's Web. | **8** |
| **UNIT 2** | Structured web documents in XML: The XML language, Structuring, Namespaces, Querying and Addressing XML documents. Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the web, UML, XML/XML Schema | **9** |
| **UNIT 3** | Web Ontology Engineering: Introduction, OWL language, Examples, OWL in OWL, Future extensions, Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods. | **9** |
| **UNIT 4** | Applications: Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods. | **8** |
| **UNIT 5** | Describing Web Resources: Introduction, RDF, RDF Schema, RDF: XML-Based Syntax, RDF serialization, syntax and language, Direct Inference System, Querying RQL, A query language for RDF: SPARQL | **8** |

| | TOTAL | 42 |
|---|---|---|

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Berners Lee, Godel and Turing, Thinking on the Web, Wiley inter science. | 2008 |
| **2** | Grigoris Antoniou and Frank Van Hermelen , A Semantic web Primer, MIT Press. | 2002 |
| **3** | John Davies, Rudi Studer, Paul Warren, Semantic Web Technologies, Trends and Research in Ontology Based Systems. | 2006 |

## GENERIC ELECTIVE COURSE-4

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Mobile Application Development** | **L** | **T** | **P** | Basic knowledge of programming languages |
| | **3** | **0** | **2** | |

**Course Objective:**1)To provide students with a comprehensive understanding of mobile application development, including the underlying platforms, tools, and frameworks.
2)To equip students with the skills to design and develop mobile applications on Android and iOS platforms using appropriate programming languages and tools.
3)To introduce cross-platform mobile application development frameworks and their advantages in creating versatile applications.
4)To emphasize the importance of mobile application security, performance optimization, and effective deployment strategies.
5)To explore advanced topics in mobile development, including augmented reality, virtual reality, and the latest trends influencing the mobile ecosystem.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand the fundamentals of mobile application development, including platform-specific and cross-platform approaches. |
| **CO2** | Design and develop functional Android and iOS applications using industry-standard tools like Android Studio and Xcode. |
| **CO3** | Implement cross-platform mobile applications using frameworks like React Native and Flutter. |
| **CO4** | Address and mitigate common security issues in mobile applications, while optimizing their performance. |
| **CO5** | Deploy mobile applications to app stores and understand the processes involved in continuous integration and delivery. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| UNIT 1 | **Introduction to Mobile Application Development**<br>Overview of Mobile Computing: Definition, Characteristics, and Applications<br>Mobile Platforms and Architectures: Android, iOS, Cross-Platform Solutions<br>Development Tools: Android Studio, Xcode, React Native, Flutter<br>Introduction to Mobile Application Lifecycle: Activities, Intents, and Services<br>Basics of UI/UX Design for Mobile Apps: Principles and Best Practices | **10** |
| UNIT 2 | **Android Application Development**<br>Android Architecture: Application Components, Manifest File, and Resources<br>User Interface Design in Android: Layouts, Views, and Widgets<br>Event Handling and Gesture Detection in Android<br>Data Storage in Android: Shared Preferences, Files, SQLite, and Room Database<br>Networking in Android: REST APIs, JSON Parsing, and Firebase Integration | **12** |
| UNIT 3 | **iOS Application DevelopmentNetworking and Communication in CPS**<br>Introduction to iOS and Swift Programming Language<br>iOS Architecture: Core iOS Components, MVC Pattern, and App States<br>User Interface Design in iOS: Storyboards, Auto Layout, and Interface Builder<br>Data Persistence in iOS: UserDefaults, Core Data, and File System<br>Networking in iOS: URLSession, Alamofire, and Firebase Integration | **10** |
| UNIT 4 | **Cross-Platform Mobile Application Development**<br>Overview of Cross-Platform Development: Advantages and Challenges<br>Introduction to React Native: Components, Navigation, and State Management<br>Introduction to Flutter: Widgets, State Management, and Navigation<br>Debugging and Testing in Cross-Platform Apps: Tools and Techniques<br>Case Study: Developing a Simple Mobile Application Using Cross-Platform Tools | **10** |
| UNIT 5 | **Advanced Topics in Mobile Application Development**<br>Mobile App Security: Common Vulnerabilities and Mitigation Strategies<br>Performance Optimization for Mobile Apps: Memory Management, Battery Usage, and Network Optimization<br>Introduction to Augmented Reality (AR) and Virtual Reality (VR) in Mobile Apps<br>Deployment and Distribution of Mobile Apps: App Store, Google Play, and Continuous Integration/Continuous Deployment (CI/CD)<br>Future Trends in Mobile Application Development: 5G, AI Integration, and Progressive Web Apps (PWAs) | **10** |
| | **TOTAL** | **42** |

| REFERENCES | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |

| | | |
|---|---|---|
| **1** | Phillips, B., Stewart, C., & Marsicano, K. Android Programming: The Big Nerd Ranch Guides. ISBN: 978-0135264027. | 2023 |
| **2** | Keur, C., & Hillegass, A. iOS Programming: The Big Nerd Ranch Guide (7th ed.).ISBN: 978-0135264713. | 2022 |
| **3** | Eisenman, B. Learning React Native: Building Native Mobile Apps with JavaScript (2nd ed.). O'Reilly Media. ISBN: 978-1492058841. | 2023 |
| 4 | Miola, A.. Flutter Complete Reference: Create & Deploy Cross-Platform Apps (2nd ed.). Packt Publishing. ISBN: 978-1801817024. | 2022 |
| 5 | DeStefano, S. Mobile App Development with Flutter: A Practical Guide (1st ed.). O'Reilly Media. ISBN: 978-1492051835. | 2022 |


| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Edge and Fog Computing** | **L** | **T** | **P** | Fundamental of Computing |
| | **3** | **1** | **-** | |

**Course Objective:** (1) To introduce the students about edge computing, fog computing, an important branch of distributed computing significant its applications in Data Science. (2)To implement the concepts of fog computing and exposes students to modern tools and API to deploy relevant infrastructures

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Explain the major components of fog and edge computing architectures. |
| **CO2** | Identify potential technical challenges of the transition process and suggest solutions. |
| **CO3** | Analyze data and application requirementswith its pertaining issues. |
| **CO4** | Design and model infrastructures in FoG and Edge Computing |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | **Introduction to Fog Computing:** Fog Computing, Characteristics, Application Scenarios,Issues andchallenges. Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-Range Technologies,LPWAN and other medium and Long-Range Technologies. | **9** |

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|---|---|---|
| **UNIT 2** | **Management and Orchestration of Network Slices in Fog and Edge:** Introduction,Background, Network Slicing in Software-Defined Clouds, Network Slicing, Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for ightweight Edge Clouds, IoT Integration, Security Managementfor Edge Cloud Architectures.Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics inthe Fog, Prototypes and Evaluation. | **8** |
| **UNIT 3** | **Fog computing requirements when applied to IoT:** Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, EventManagement, Device Management, loudification, virualization, security and privacy issues. IntegratingIoT, Fog, Cloud Infrastructures: Methodology, Integrated C2F2T Literature by Modeling Technique byUse-Case Scenarios, Integrated C2F2T Literature by Metrics | **8** |
| **UNIT 4** | **Introduction to Edge Computing Scenarios and Use cases -** Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog, and M2M. | **6** |
| **UNIT 5** | **Exploiting Fog/Edge Computing in Health Monitoring:** An Architecture of a Health Monitoring IoT Based System with Fog/Edge Computing, Fog/Edge Computing Services in Smart E-Health Gateways, Discussion of Connected Components. **Fog/Edge Computing Model for Evolving Smart Transportation Applications:** Introduction, Data-Driven Intelligent Transportation Systems, Fog/Edge Computing for Smart Transportation, Applications Case Study: Intelligent Traffic Lights Management (ITLM) System. | **11** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| 1 | Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya, Wiley. | 2020 |
| 2 | IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806 | 2020 |
| 3 | Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama, ISBN: 978-1-119-52498-4 | 2019 |
| 4 | Amir Vahid Dastjerdi and Rajkumar Buyya, ―Fog Computing: Helping the Internet of ThingsRealize its Potential, University of Melbourne | 2016 |

| B.Tech. Information Technology | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Cognitive Computing** | **L** | **T** | **P** | Artificial intelligence and Machine learning |
| | **3** | **0** | **2** | |

**Course Objective::** Define cognitive computing and elucidate its core components. Investigate machine learning techniques applied in cognitive systems. Learn computer vision for cognitive systems, speech recognition, and audio processing, and learn how to integrate sensor data for enhanced cognitive capabilities.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | Understand the concepts of Cognitive models and their architectures. |
| **CO2** | Apply and analyze various machine learning algorithms in cognitive computing. |
| **CO3** | Examine and integrate sensor data in Cognitive computing. |
| **CO4** | Demonstrate the cognitive computing concepts to practical scenarios. |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Introduction to Cognitive Computing: Definition and Evolution of Cognitive Computing KeyComponents: AI, Machine Learning, Natural Language Processing Historical Perspectives and Milestones in Cognitive Computing Cognitive Models and Architectures: Overview of Cognitive Architectures Connectionist Models: Neural Networks and Deep Learning Symbolic Models: Rule-Based Systems and Expert Systems | **8** |
| **UNIT 2** | Cognitive Computing Algorithms: Machine Learning for Cognitive Systems ReinforcementLearning in Cognitive Computing Evolutionary Algorithms and Swarm Intelligence Natural Language Processing (NLP) in Cognitive Computing: Basics of Natural Language Processing NLP for Understanding and Generating Human-Like Text Sentiment Analysis andLanguage Models | **6** |
| **UNIT 3** | Perception and Sensing: Computer Vision in Cognitive Computing Speech Recognition and Audio processing Integrating Sensor Data for Cognitive Systems | **6** |
| **UNIT 4** | Human-Computer Interaction (HCI) in Cognitive Computing: Principles of HCI Designing User Interfaces for Cognitive Systems Multimodal Interaction: Combining Voice, Gesture, and Touch | **7** |

| | | |
|---|---|---|
| **UNIT 5** | Cognitive Applications in Industry: Healthcare and Cognitive Computing Finance and CognitiveAnalytics Smart Cities and Cognitive Technologies Ethical and Social Implications of Cognitive Computing: Privacy Concerns in Cognitive SystemsBias and Fairness in Cognitive Algorithms Ethical Design and Responsible AI | **9** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | Michael Negnevitsky , "Cognitive Computing: A Practical Guide", Pearson | 2019 |
| **2** | Vint Cerf and Peter Fingar, "Cognitive Computing: A Brief Guide for Game Changers"Meghan Kiffer Pr | 2015 |
| **3** | Shahram Ebadollahi, Kathleen McKeown and Ronnie Mitra, "Cognitive Computing and the Future of Health Care", IBM Redbooks | 2016 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Neuromorphic computing** | **L** | **T** | **P** | Electronics, sensors, deep learning, computer vision |
| | **3** | **1** | **0** | |

**Course Objective:** To familiarize students with the concept of Neuromorphic computing.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the Biological Foundations of Neuromorphic Computing |
| **CO2** | Design and Analyze Neuromorphic Hardware Architectures |
| **CO3** | Implement and Evaluate Neuromorphic Algorithms for Real-World Applications |
| **CO4** | Apply Simulation Tools to Model and Test Neuromorphic Systems |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to Neuromorphic Computing: Foundations of Neuroscience, Neurons and Synapses, Biological neuron structure and function. Synaptic plasticity, Hebbian learning. Neural Networks, Structure and function of biological neural networks.Information processing in the brain. Spiking Neural Networks (SNNs) Neuron models: integrate-and-fire, Hodgkin-Huxley. Temporal encoding and spike-timing-dependent plasticity (STDP). | **8** |

| | | |
|---|---|---|
| **UNIT 2** | Neuromorphic Hardware and Neuromorphic Processors:<br>Overview of neuromorphic chips (e.g., IBM TrueNorth, Intel Loihi).<br>Design principles and architecture of neuromorphic hardware.<br>Analog and Digital Circuits, Analog VLSI for neuromorphic systems.<br>Mixed-signal circuits, CMOS technology in neuromorphic design.<br>Memristors and Emerging Devices, Memristor theory and applications in neuromorphic systems. | **10** |
| **UNIT 3** | Neuromorphic Algorithms Learning Algorithms:<br>Supervised, unsupervised, and reinforcement learning in SNNs.<br>STDP, spike-based learning rules. Pattern Recognition and Sensory Processing,<br>Neuromorphic approaches to vision, auditory, and tactile processing,<br>Neuromorphic Control Systems | **8** |
| **UNIT 4** | Simulation Tools and Software Simulation Platforms:<br>NEURON, NEST, BindsNET, and other neuromorphic simulators.<br>Programming Models<br>Programming frameworks for neuromorphic hardware (e.g., PyNN, Lava).<br>Toolchains for Neuromorphic Design<br>CAD tools for neuromorphic VLSI design.<br>Integration of hardware and software in neuromorphic systems. | **8** |
| **UNIT 5** | Neuromorphic System Design System-Level Design:<br>Architectures of large-scale neuromorphic systems. Network-on-Chip (NoC) for neuromorphic systems. Integration with Sensors and Actuators<br>Interface design for neuromorphic sensors (e.g., dynamic vision sensors).<br>Real-time neuromorphic processing for robotics and IoT. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**

| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Neuromorphic Engineering: From Neural Systems to Brain-Like Circuits" by Elisabetta Chicca, Giacomo Indiveri, and Stefan J. Thorpe (2021) | 2021 |
| **2** | Introduction to Neuromorphic Computing" by S. Rajasekaran and G. A. Vijayalakshmi Pai (2021) | 2021 |
| **3** | Learning in Energy-Efficient Neuromorphic Computing: Algorithm, Architecture, and System" by Qingwei Li, Yiran Chen, and Yuan Xie (2020) | 2020 |
| 4 | Brain-Inspired Computing: The Next Revolution in Computational Neuroscience" by Anup Basu (2017) | 2017 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code:** | **Course Structure** | | | **Pre-Requisite** |
| **Optimization Techniques** | **L** | **T** | **P** | |
| | **3** | **1** | **0** | |

**Course Objective::** To familiarize with various optimization techniques and their applications.

| S. NO | Course Outcomes (CO) |
|---|---|
| **CO1** | To describe various concepts of linear programming |
| **CO2** | To perform Duality Theory and Sensitivity Analysis |
| **CO3** | To solve problems using Dynamic Programming |
| **CO4** | To solve problems using Integer Programming |
| **CO5** | To solve problems using Integer Programming |

| S. NO | Contents | Contact Hours |
|---|---|---|
| **UNIT 1** | Linear Programming of Linear Programming, Additional Examples, Some Classic Case Studies. Graphical method, The Simplex Method: The Essence of the Simplex Method, Setting up the Simplex Method, The Algebra of the Simplex Method, The Simplex Method in Tabular Form, Tie Breaking in the Simplex Method, Adapting to Other Model Forms, Post optimality Analysis. | **8** |
| **UNIT 2** | Duality theory and Essence of Duality Theory, Economic Interpretation of Duality, Primal-Dual relationships, Adapting to Other Primal Forms, The Role of Duality Theory in Sensitivity Analysis. Algorithms for Linear Programming: The Dual Simplex Method, Parametric Linear Programming, the Upper Bound Techniques, An Interior-Point Algorithm. | **6** |
| **UNIT 3** | Dynamic programming, prototype example for Dynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming, Probabilistic Dynamic Programming. | **6** |
| **UNIT 4** | Integer Programming and Prototype Example, Some BIP Applications, Innovative Uses of Binary Variables in Model Formulation, Some Formulation examples, Some Perspectives on Solving Integer Programming Problems, The Branch-and-Bound Technique and Its application to Binary Integer Programming, A Branch-and-Bound Algorithm for Mixed Integer. | **8** |
| **UNIT 5** | Nonlinear Programming and Sample Applications, Graphical Illustration of Nonlinear Programming Problems, Types of Nonlinear Programming Problems, One-Variable Unconstrained Optimization, Multivariable Unconstrained Optimization, The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization, Quadratic Programming, Separable Programming, Convex Programming. | **8** |

| | | |
|---|---|---|
| **UNIT6** | Discussion about the Queuing Theory and Prototype Example, Basic Structure of queuing Models, Examples of Real Queuing Systems, The role of the Exponential Distribution, The Birth-and-Death Process, Queuing Models Based on the Birth-and Death Process, Queuing Models involving non exponential distributions. | **6** |
| | **TOTAL** | **42** |

| **REFERENCES** | | |
|---|---|---|
| **S.No.** | **Name of Books/Authors/Publishers** | **Year of Publication / Reprint** |
| **1** | H.A.Taha – Operations Research, 8/e , Pearson Education , New Delhi, | 2007 |
| **2** | J.K. Sharma – Operations Research, 3/e, Mcmillan , India Ltd | 2007 |
| **3** | S. Hiller & G.J. Lieberman – Operations Research, 8th Edn, TMH, New Delhi | 2006 |

| **B.Tech. Information Technology** | | | | |
|---|---|---|---|---|
| **Course code: Course Title** | **Course Structure** | | | **Pre-Requisite** |
| **Pervasive and Ubiquitous Computing** | **L** | **T** | **P** | Mobile Networks, Sensors, Networks, Security |
| | **3** | **1** | **0** | |

**Course Objective:** To familiarize students with the concepts and utility of Pervasive and Ubiquitous Computing.

| **S. NO** | **Course Outcomes (CO)** |
|---|---|
| **CO1** | Understand the Core Concepts and Technologies of Pervasive and Ubiquitous Computing |
| **CO2** | Design and Develop Context-Aware Ubiquitous Systems |
| **CO3** | Address Security and Privacy Challenges in Ubiquitous Environments |
| **CO4** | Explore and Apply Emerging Trends in Pervasive Computing |

| **S. NO** | **Contents** | **Contact Hours** |
|---|---|---|
| **UNIT 1** | Introduction to Pervasive and Ubiquitous Computing: Definition and concepts of pervasive and ubiquitous computing. Evolution from traditional computing to pervasive environments. Key characteristics: invisibility, context-awareness, and adaptive behavior. | **8** |

| | | |
|---|---|---|
| **UNIT 2** | Enabling Technologies: Wireless Communication Wi-Fi, Bluetooth, Zigbee, RFID, and NFC.<br>Mobile and sensor networks. Embedded Systems Microcontrollers, embedded operating systems.<br>Internet of Things (IoT) devices and platforms. Context-Aware Computing Sensors and context acquisition. Context modeling and reasoning. | **10** |
| **UNIT 3** | Human-Computer Interaction (HCI): Natural User Interfaces (NUIs)<br>Touch, gesture, voice recognition. Wearable Computing<br>Wearable devices and their interaction models.<br>Augmented Reality (AR)<br>Integration of AR in ubiquitous systems. | **8** |
| **UNIT 4** | Middleware for Ubiquitous Computing<br>Middleware Architectures and Service-oriented architecture (SOA): Event-driven and agent-based middleware.<br>Resource Management Context-aware resource allocation. Power management in pervasive environments.<br>**Security and Privacy:**<br>Challenges in Pervasive Computing , Authentication, data privacy, and access control. Privacy-Preserving Techniques | **8** |
| **UNIT 5** | **Applications of Pervasive Computing**<br>Smart Homes and Buildings, Automation, energy management, and security systems, Healthcare Wearable health monitors, remote patient monitoring.<br>Smart Cities Transportation systems, environmental monitoring, Retail and Marketing, Location-based services, personalized advertising. | **8** |
| | **TOTAL** | **42** |

**REFERENCES**


| S.No. | Name of Books/Authors/Publishers | Year of Publication / Reprint |
|---|---|---|
| **1** | Pervasive Computing: Technology and Architecture of Mobile Internet Applications" by Uwe Hansmann, Lothar Merk, Martin S. Nicklous, and Thomas Stober | 2003 |
| **2** | Ubiquitous Computing Fundamentals" edited by John Krumm | 2010 |
| **3** | "Pervasive Computing: Concepts, Technologies, and Applications" by Minyi Guo, Jingyu Zhou, Feilong Tang, and Yao Shen | 2016 |
| 4 | Security and Privacy in Ubiquitous Computing by Stefan Poslad | 2009 |