



# BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

## M.Sc. INFORMATION TECHNOLOGY

### CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

| Sem                                                                                           | Course                                               | Course Title                                        | Ins.<br>Hrs | Credit | Exam<br>Hrs | Marks |     | Total |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|-------------|--------|-------------|-------|-----|-------|
|                                                                                               |                                                      |                                                     |             |        |             | Int.  | Ext |       |
| I                                                                                             | Core Course - 1 (CC - 1)                             | Mathematical Foundations for Information Technology | 6           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Core Course - 2 (CC - 2)                             | Advanced Data Structures                            | 6           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Core Practical - 1 (CP - 1)                          | Advanced Data Structures Lab                        | 3           | 2      | 3           | 40    | 60  | 100   |
|                                                                                               | Discipline Centric Elective Course - 1 (DCEC - 1)    | Any one from the list                               | 5           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Discipline Centric Elective Practical - 1 (DCEP - 1) | Any one from the list                               | 3           | 2      | 3           | 40    | 60  | 100   |
|                                                                                               | Generic Elective Course - 1 (GEC - 1)                | Any one from the list                               | 5           | 3      | 3           | 30    | 70  | 100   |
|                                                                                               | Skill Enhancement Course - 1 (SEC - 1)               | Web Technology                                      | 2           | 2      | 3           | 30    | 70  | 100   |
|                                                                                               | Value Added Course - 1 (VAC - 1) *                   | UI/UX Design                                        | -           | 2*     | 3           | 30    | 70  | 100*  |
|                                                                                               | Total                                                |                                                     |             | 30     | 21          | -     | -   | -     |
| II                                                                                            | Core Course - 3 (CC - 3)                             | Operating Systems and Shell Programming             | 6           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Core Course - 4 (CC - 4)                             | C# with .NET Programming                            | 6           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Core Practical - 2 (CP - 2)                          | C# with .NET Programming Lab                        | 3           | 2      | 3           | 40    | 60  | 100   |
|                                                                                               | Discipline Centric Elective Course - 2 (DCEC - 2)    | Any one from the list                               | 4           | 4      | 3           | 30    | 70  | 100   |
|                                                                                               | Discipline Centric Elective Practical - 2 (DCEP - 2) | Any one from the list                               | 3           | 2      | 3           | 40    | 60  | 100   |
|                                                                                               | Generic Elective Course - 2 (GEC - 2)                | Any one from the list                               | 4           | 3      | 3           | 30    | 70  | 100   |
|                                                                                               | Skill Enhancement Course - 2 (SEC - 2)               | Soft Skills                                         | 2           | 2      |             | 30    | 70  | 100   |
|                                                                                               | Non-Major Elective - 1 (NME -1)                      | One Course from Outside Department                  | 2           | 2      | 3           | 30    | 70  | 100   |
|                                                                                               | Total                                                |                                                     |             | 30     | 23          | -     | -   | -     |
| Summer Internship / Industrial Activity during the Summer Vacation after 1 <sup>st</sup> Year |                                                      |                                                     |             |        |             |       |     |       |

| Sem         | Course                                               | Course Title                                     | Ins. Hrs | Credit | Exam Hrs | Marks |     | Total |
|-------------|------------------------------------------------------|--------------------------------------------------|----------|--------|----------|-------|-----|-------|
|             |                                                      |                                                  |          |        |          | Int.  | Ext |       |
| III         | Core Course - 5 (CC - 5)                             | Artificial Intelligence and Machine Learning     | 6        | 4      | 3        | 30    | 70  | 100   |
|             | Core Course - 6 (CC - 6)                             | Quantum Computing Fundamentals                   | 6        | 4      | 3        | 30    | 70  | 100   |
|             | Core Practical - 3 (CP - 3)                          | Artificial Intelligence and Machine Learning Lab | 3        | 2      | 2        | 40    | 60  | 100   |
|             | Discipline Centric Elective Course - 3 (DCEC - 3)    | Any one from the list                            | 5        | 4      | 3        | 30    | 70  | 100   |
|             | Discipline Centric Elective Practical - 3 (DCEP - 3) | Any one from the list                            | 3        | 2      | 2        | 40    | 60  | 100   |
|             | Generic Elective Course - 3 (GEC - 3)                | Any one from the list                            | 5        | 3      | 3        | 30    | 70  | 100   |
|             | Non-Major Elective - 2 (NME - 2)                     | One Course from Outside Department               | 2        | 2      | 3        | 30    | 70  | 100   |
|             | Summer Internship / Industrial Activity @            |                                                  |          | 2      |          | 20    | 80  | 100   |
|             | Total                                                |                                                  | 30       | 23     | -        | -     | -   | 800   |
| IV          | Core Course - 7 (CC - 7)                             | Cloud Computing and Internet of Things           | 4        | 4      | 3        | 30    | 70  | 100   |
|             | Core Course - 8 (CC - 8)                             | Block Chain Technologies                         | 4        | 4      | 3        | 30    | 70  | 100   |
|             | Core Course - 9 (CC - 9)                             | Software Project Management                      | 4        | 4      | 3        | 30    | 70  | 100   |
|             | Discipline Centric Elective Course - 4 (DCEC - 4)    | Any one from the list                            | 4        | 4      | 2        | 30    | 70  | 100   |
|             | Entrepreneurship / Industry Based Course @           | Startups and Entrepreneurship                    | 4        | 3      | 3        | 30    | 70  | 100   |
|             | Project Work @                                       | Project Report                                   | 5        | 5      | -        | 20    | 80  | 100   |
|             | Value Added Course - 2 (VAC - 2) *                   | Data Analysis with R                             | -        | 2*     | 3        | 30    | 70  | 100*  |
|             | Total                                                |                                                  | 30       | 24     | -        | -     | -   | 600   |
| Grand Total |                                                      |                                                  |          | 91     |          |       |     | 2900  |

## LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE / PRACTICAL

| Discipline Centric Elective Course 1 |                                 | Discipline Centric Elective Practical 1 |                                     |
|--------------------------------------|---------------------------------|-----------------------------------------|-------------------------------------|
| 1.                                   | Advanced Java Programming       | 1.                                      | Advanced Java Programming Lab       |
| 2.                                   | Big Data Analytics              | 2.                                      | Big Data Analytics Lab              |
| Discipline Centric Elective Course 2 |                                 | Discipline Centric Elective Practical 2 |                                     |
| 1.                                   | Advanced Python Programming     | 1.                                      | Advanced Python Programming Lab     |
| 2.                                   | Natural Language Processing     | 2.                                      | Natural Language Processing Lab     |
| Discipline Centric Elective Course 3 |                                 | Discipline Centric Elective Practical 3 |                                     |
| 1.                                   | Full Stack Development          | 1.                                      | Full Stack Development Lab          |
| 2.                                   | Cryptography and Cyber Security | 2.                                      | Cryptography and Cyber Security Lab |
| Discipline Centric Elective Course 4 |                                 |                                         |                                     |
| 1                                    | Generative AI                   |                                         |                                     |
| 2                                    | E-Commerce Technologies         |                                         |                                     |

## LIST OF NON-MAJOR ELECTIVE COURSE (for other Department Students only)

| NON-MAJOR ELECTIVE COURSE – 1 (NME-1) |                               |
|---------------------------------------|-------------------------------|
| 1                                     | Digital Marketing             |
| NON-MAJOR ELECTIVE COURSE – 2 (NME-2) |                               |
| 2                                     | Principles of Web Programming |

## LIST OF GENERIC ELECTIVE COURSE

| Generic Elective Course 1 |                                                        |
|---------------------------|--------------------------------------------------------|
| 1.                        | E-Learning Techniques                                  |
| 2.                        | Optimization Techniques                                |
| 3.                        | Digital Marketing Analytics                            |
| Generic Elective Course 2 |                                                        |
| 1.                        | Organisational Behaviour and Human Resource Management |
| 2.                        | Design Thinking                                        |
| 3.                        | Data Analysis Using SPSS                               |
| Generic Elective Course 3 |                                                        |
| 1.                        | Biological Databases                                   |
| 2.                        | Research Methodology and IPR                           |
| 3.                        | Green Computing and Sustainability                     |

## SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES: SCIENCE

| Sl. No.               | Types of the Course                        | No. of Courses | Credits for each Course | Total Credits | Marks       |
|-----------------------|--------------------------------------------|----------------|-------------------------|---------------|-------------|
| 1.                    | Core Course                                | 9              | 4                       | 36            | 900         |
| 2.                    | Core Practical                             | 3              | 2                       | 6             | 300         |
| 3.                    | Discipline Centric Elective Course         | 4              | 4                       | 16            | 400         |
| 4.                    | Discipline Centric Elective Practical      | 3              | 2                       | 6             | 300         |
| 4.                    | Generic Elective Course                    | 3              | 3                       | 9             | 300         |
| 5.                    | Skill Enhancement Course                   | 2              | 2                       | 4             | 200         |
| 6.                    | Non-Major Elective Courses                 | 2              | 2                       | 4             | 200         |
| 7.                    | Internship / Industrial Activity @         | 1              | 2                       | 2             | 100         |
| 8.                    | Entrepreneurship / Industry Based Course @ | 1              | 3                       | 3             | 100         |
| 9.                    | Project @                                  | 1              | 5                       | 5             | 100         |
| <b>Total</b>          |                                            | <b>29</b>      | <b>-</b>                | <b>91</b>     | <b>2900</b> |
| Value Added Courses * |                                            | 2*             | 2                       | 4*            | 200*        |

| *           | <p><b>The value-added courses credit will not be included in the total CGPA. These courses are extra-credit courses.</b></p> <p><b>Instruction hours for these courses is 30 hours</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |       |        |    |      |    |       |     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------|--------|----|------|----|-------|-----|
| @           | <p>Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3<sup>rd</sup> semester Mark Statement.</p> <p><b>Summer Internship / Industrial Activity&amp; Project Scheme of Evaluation:</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Description</th><th style="text-align: center;">Marks</th></tr> <tr> <td>Report</td><td style="text-align: center;">80</td></tr> <tr> <td>Viva</td><td style="text-align: center;">20</td></tr> <tr> <td>Total</td><td style="text-align: center;">100</td></tr> </table> | Description | Marks | Report | 80 | Viva | 20 | Total | 100 |
| Description | Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |       |        |    |      |    |       |     |
| Report      | 80                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |       |        |    |      |    |       |     |
| Viva        | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |       |        |    |      |    |       |     |
| Total       | 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |       |        |    |      |    |       |     |

## Programme Outcome

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PO1</b>   | <b>Disciplinary Knowledge:</b> Broad and in-depth knowledge of advanced scientific concepts, principles, and methodologies within the chosen domain. Ability to critically explain, integrate, and apply scientific knowledge to theoretical and practical problems. Opportunities to earn additional credits through specialized and interdisciplinary courses further enhance expertise and broaden disciplinary understanding.                                                        |
| <b>PO 2</b>  | <b>Critical Thinking:</b> Field visits, academic interactions, and experiential learning activities will help students develop critical observation, interpretation, and analytical skills. Ability to evaluate and interpret scientific data, formulate hypotheses, and draw logical conclusions. Encourages independent thinking and the ability to assess scientific problems from multiple perspectives.                                                                             |
| <b>PO 3</b>  | <b>Analytical Reasoning:</b> Through classroom discussions, scientific literature reviews, and interactive learning environments, students will strengthen their analytical reasoning abilities. Ability to critically evaluate scientific texts, identify gaps in existing knowledge, formulate research questions, and synthesize new ideas and concepts. Promotes evidence-based reasoning and logical interpretation of scientific information.                                      |
| <b>PO 4</b>  | <b>Scientific Reasoning:</b> Strong foundation in scientific methods, experimental design, and data interpretation through laboratory-based courses. Enhances practical knowledge of scientific instrumentation, calibration procedures, laboratory safety, and appropriate research techniques. Ability to conduct scientifically sound experiments and interpret results accurately.                                                                                                   |
| <b>PO 5</b>  | <b>Self-Directed Learning:</b> Encourages independent and self-directed learning through assignments, field reports, project work, and literature-based studies. Ability to organize, analyze, and present scientific findings in professional formats relevant to academic and industrial settings. Fosters responsibility, time management, and continuous self-improvement in learning.                                                                                               |
| <b>PO 6</b>  | <b>Reflective Thinking:</b> Laboratory-intensive core courses will expose students to a broad range of research methodologies and experimental techniques. Ability to reflect on learning experiences, evaluate the effectiveness of scientific approaches, and understand the broader applications of scientific techniques within the discipline.                                                                                                                                      |
| <b>PO 7</b>  | <b>Problem-Solving Skills:</b> Ability to develop and apply scientific principles, quantitative reasoning, and mathematical concepts to solve discipline-specific problems. Ability to analyze experimental data, interpret scientific observations, and derive meaningful conclusions. Prepares students to address real-world scientific and societal challenges effectively.                                                                                                          |
| <b>PO 8</b>  | <b>Research-Related Skills:</b> Internships, dissertation work, and research-oriented projects provide opportunities to design, develop, and execute independent research studies. Students gain hands-on experience in research methodology, experimental techniques, data analysis, scientific writing, and ethical research practices. These experiences strengthen laboratory competence and prepare students for advanced research and professional careers.                        |
| <b>PO 9</b>  | <b>Lifelong Learning:</b> Cultivates a mindset of continuous learning and professional adaptability. Ability to identify gaps in knowledge and skills, adapt to emerging technologies and scientific advancements, and pursue self-directed learning throughout their careers. Encourages lifelong learning that supports academic growth, employability, and professional excellence.                                                                                                   |
| <b>PO 10</b> | <b>Leadership Readiness:</b> Ability to take initiative, work collaboratively, and manage academic and research responsibilities effectively. Through seminars, group projects, internships, and research activities, students develop decision-making, problem-solving, organizational, and interpersonal skills. Ability to lead scientific teams, communicate effectively in professional environments, and contribute responsibly to academic, industrial, and societal development. |

## **Programme Specific Outcome**

**PSO1** – Apply advanced concepts of information technology, computer science, programming, databases, networking, and software engineering to solve real-world problems.

**PSO2** –Design, develop, test, and deploy efficient software applications using appropriate programming languages, frameworks, databases, and modern development tools.

**PSO3** – Analyze and apply emerging technologies such as Artificial Intelligence, Machine Learning, Cloud Computing, Data Analytics, Cybersecurity, and Internet of Things to address contemporary IT challenges.

**PSO4** – Identify complex computing problems, evaluate alternative solutions, and develop innovative, reliable, and scalable IT solutions using analytical and computational skills.

**PSO5** – Demonstrate effective communication, teamwork, ethical responsibility, project management, and lifelong learning skills required for successful careers in the IT industry, research, and higher education.

**PSO6** - Generate solutions by conducting experiments and applying techniques to analyze and interpret data

**PSO7** - Comprehend professional and ethical responsibility in computing profession.

**PSO8** - Express effective communication skills.

**PSO9** - Analyze computational problems and develop innovative, scalable, secure, and reliable technology-based solutions.

**PSO10** - Industry & Team Readiness: Competence to work efficiently in multidisciplinary teams, adhere to professional ethics, and meet corporate or business standards

**Course Objectives: After completing this course, students will be able to:**

- 1.Introduce set theory and functions. □
- 2.Expose the concept of logic and hence to construct valid mathematical arguments.
- 3.Master combinatorics which deals with the counting principles. □
4. Introduce formal languages and finite state automata. □
5. Learn network scheduling

**UNIT – I: FUNDAMENTAL STRUCTURES:** Set theory- Relationships between sets – Operations on sets – Set identities – Principle of inclusion and exclusion – Minsets- Relations- Binary relations – Partial orderings – Equivalence relations – Functions- Properties of functions – Composition of functions – Inverse functions.

**UNIT – II: LOGIC:** Propositional logic – Logical connectives – Truth tables – Normal forms (conjunctive and disjunctive) – Predicate logic – Universal and existential quantifiers – Proof techniques (direct and indirect).

**UNIT – III: COMBINATORICS:** Mathematical Induction – Strong induction and well-ordering- Basics of counting – Counting arguments – Pigeonhole principle – Permutations and Combinations – Recurrence relations Solving linear recurrence relations – Generating functions.

**UNIT – IV: FORMAL LANGUAGES& FINITE AUTOMATA:** Formal Languages – Classes of Grammars – Phrase structure – Context sensitive – Context Free – Regular Grammars – Finite State Automata – Non- Deterministic Finite State Automata – Deterministic Finite State Automata.

**UNIT – V: NETWORK SCHEDULING BY PERT AND CPM:** Network construction- Critical path method(CPM)-time charts and resource leveling- Project evaluation and review technique(PERT)- resource analysis in network scheduling-Minimal spanning tree-Shortest route.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Judith L.Gersting, “Mathematical Structures for Computer Science”, W.H.Freeman and Company, NY, 2012.
2. Kenneth H. Rosen, “Discrete Mathematics and its Applications”,seventhth edition,TMH, 2013.
3. M.K. Venkataraman, N. Sridharan and N.Chandrasekaran,“ Discrete Maths.”,The National Publishing Company, 2012.
4. Hopcraft.J.E., Motwani.R., Ullman.J.D., Introduction to Automata Theory, Languages and Computations”, 3rd Edition, Pearson Education, 2008.

**REFERENCES:**

1. John.C.Martin, "Introduction to Languages and Theory of Computation", 4th edition, Tata McGraw Hill, 2011.
2. Hamdy A Taha, "Operations Research – An Introduction", Pearson, 10th Edition, 2016.

**COURSE OUTCOMES:** Upon completion of the course, students will be able to:

CO1: Use the set theory concepts to understand the structures of functions.

CO2: Expertise the knowledge of logics helps to verify the correctness of computer programs and to draw conclusions from scientific experiments.

CO3: Demonstrate the applications of basic concepts of an algorithm and counting principles in combinatorial mathematics.

CO4: Construct finite automata machines using automata theory and formal languages.

CO5: Apply optimum network scheduling using PERT and CPM

**Course Objectives: After completing this course, students will be able to:**

1. Develop an understanding of advanced data structures and their applications in computer science.
2. Analyze and implement data structures such as trees, graphs, heaps, hash tables, and advanced linked structures.
3. Develop efficient algorithms for searching, sorting, traversal, insertion, deletion, and other data manipulation operations.
4. Analyze the time and space complexity of data structure operations and select appropriate structures for specific problems.
5. Apply advanced data structures to solve complex computational and real-world problems efficiently.

**UNIT – I: Concept of data structures:** Types of data structures, examples. Introduction to algorithms, Performance analysis - Space complexity, Time complexity, Amortised complexity, Asymptotic notations, Performance measurement; Various algorithm designing techniques-Divide and conquer, Greedy method, Dynamic programming, Backtracking, Branch and bound, Np-hard and Np-completeness problems.

**UNIT – II: Arrays:** Organization, Representation and implementation of arrays, examples. Implementation of Stacks and Queues, Circular Queues, Priority Queues, Double ended queues, Applications of stacks and queues. Sorting and Searching techniques: Linear and Binary search, Selection sort, Merge sort, Simple insertion sort, Quick sort, Shell sort, Radix sort.

**UNIT – III: Lists:** Representation and implementation of singly linked list, Circular linked lists, doubly linked list, Linked list representation of stacks and queues, examples. Dynamic storage management. Boundary tag system. Garbage collection and compaction.

**UNIT – IV: Trees:** Representation and Implementation, Binary trees, insertion and deletion of nodes in binary tree, binary tree traversals, Binary search trees, Threaded Binary trees, Balanced trees (AVL trees), B- trees- Insertion and Deletion of nodes, Tree search

**UNIT – V: Graphs:** Directed Graphs, Shortest Path Problem, Undirected Graph, Spanning Trees, Techniques for graphs –Breadth First Search (BFS) and traversal, Depth First Search (DFS) and traversal Hashing: Static hashing, hash tables, hash functions, overflow handling.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Robert Lafore, Data structures and Algorithms in Java, Pearson Publications
2. Clifford A Shaffer, Data Structures and Algorithm analysis in Java Programme

**Reference Books:**

1. G S Baluja, Data structures Through C++
2. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data structure

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Explain and analyze advanced data structures and their applications in solving computational problems.

CO2: Implement and apply advanced tree structures such as AVL trees, B-trees, heaps, and tries for efficient data organization and retrieval.

CO3: Design and implement graph-based algorithms for traversal, shortest paths, spanning trees, and other graph-related problems.

CO4: Analyze and apply hashing techniques, priority queues, and advanced searching and sorting methods for efficient data processing.

CO5: Evaluate the time and space complexity of data structure operations and select appropriate data structures for specific applications.

**List of Practicals (Using C/C++/Java):**

1. Write a program that uses functions to perform the following operations on singly linked List (i) Creation (ii) Insertion (iii) Deletion (iv) Traversal.
2. Write a program that uses functions to perform the following operations on doubly linked List (i) Creation (ii) Insertion (iii) Deletion (iv) Traversal.
3. Write a program that uses functions to perform the following operations on circular linked List (i) Creation (ii) Insertion (iii) Deletion (iv) Traversal.
4. Write a program that implement stack (its operations) using (i) Arrays (ii) Linked list (Pointers).
5. Write a program that implement Queue (its operations) using (i) Arrays (ii) Linked list (Pointers).
6. (i) Write a program that implement Circular Queue (its operations) using Arrays. (ii) Write a program that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a) Linear search b) Binary search.
7. Write a program that implements the following sorting 1. Bubble sort 2. Selection sort 3. Quick sort.
8. Write a program that implements the following 1. Insertion sort 2. Merge sort 3. Heap sort.
9. Write a program to implement all the functions of a dictionary (ADT) using Linked List.
10. Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.
11. Write a program to implement the tree traversal methods.
12. Write a program to perform the following operations: a) Insert an element into a AVL tree. b) Delete an element from a AVL tree. c) Search for a key element in a AVL tree.

**Course Objectives: After completing this course, students will be able to"**

1. Introduce advanced concepts of Java programming, including multithreading, exception handling, collections, generics, and file processing.
2. Develop students' ability to design and implement robust, modular, reusable, and object-oriented Java applications.
3. Familiarize students with database connectivity using JDBC and the development of database-driven applications.
4. Provide knowledge of Java-based web application development
5. Introduce commonly used Java frameworks, APIs, and enterprise application development concepts.

**UNIT – I: Object Oriented Programming Concepts and Basics of Java:** Java Programming Environment – JDK, Java Virtual Machine, Bytecode, Features of Java Flow Control Statements – Conditional Statements, Iteration Statements, Jump Statements Arrays –One Dimensional Array, Multi-dimensional Array, Object Oriented Programming Concepts- (Objects and Classes, Encapsulation, Inheritance, Polymorphism) , Type of Inheritance , Method Overloading, Method Overriding, Dynamic Method Dispatch

**UNIT – II: Input/Output Handling:** Constructors- Constructor Overloading, this, super, final, abstract and static Keywords, Interfaces- Defining an Interface, Implementing Interface, Extending Interfaces. String - String Handling Fundamentals, Comparison of String and String Buffer Class, Special String Operations- Character Extraction, String Comparison, Searching String, Modifying a String, String Copy, Input and Output Streams – Byte Stream, Character Stream

**UNIT – III: Packages:** Exception Handling and Thread Packages – Defining Packages, Built in Packages(java.lang, java.util, java.io, java.net, javax.swing), Importing Packages, Implementation of User Defined Packages, Access Protection in Java, Exception Handling - try, catch, throw, throws and finally Statements, Java's Built-in Exceptions, Creating User Defined Exceptions. Threads- Thread Lifecycle, Thread Priorities, The Thread Class, Runnable Interface, Creating a Thread – Implementing Runnable, Extending Thread , Inter Thread Communication, Suspending Resuming and Stopping Threads.

**UNIT – IV: GUI Programming:** Basic Event Handling – Delegation Event Model, Important Event Classes And Listener Interfaces, Handling Mouse and Keyboard Events, Adapter Classes, Swing -Window Fundamentals – Class Hierarchy, Frame, Creating a Simple Window Based Application, ImageIcon, JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JList, JComboBox, JTable, JTabbedPane, JScrollPane, Layout Management – The FlowLayout, BorderLayout, GridLayout, CardLayout

**UNIT – V: File, Database and Networking:** File Management - Reading and Writing Files (FileInputStream and FileOutputStream Classes), Networking

Basics- Networking Classes and Interfaces, InetAddress, TCP/IP Client Sockets, URL Connection, TCP/IP ServerSockets, JDBC - The Design of JDBC, JDBC Configuration, Executing SQL Statements- Scrollable and Updatable ResultSets, RowSets, Transactions.

**UNIT – VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester Concerned

**Text Books**

1. Herbert Schildt, Java 2 The Complete Reference, Tata McGraw Hill (5thEdn.)
2. James. P. Cohoon, Programming java5.0, Jack. W. Davison (Tata McGraw Hill)
3. C Thomas Wu, An introduction to Object Oriented Programming with Java, Tata McGraw Hill, (2006)

**Reference Books:**

1. Wigglesworth and McMillan, Java Programming: Advanced Topics, Cengage Learning India, 3rdEdn.
2. Bernard Van Haecke, JDBC: Java Database Connectivity, IDG Books India (2000) CA020103

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Apply advanced Java programming concepts, including multithreading, exception handling, collections, generics, and file handling.

CO2: Develop robust, modular, and reusable applications using object-oriented programming principles and advanced Java features.

CO3: Design and implement database-driven Java applications using JDBC and appropriate database connectivity techniques.

CO4: Develop web-based applications using Java technologies

CO5: Apply Java frameworks and APIs to build scalable, secure, and maintainable enterprise-level applications.

|                |                                                         |                    |
|----------------|---------------------------------------------------------|--------------------|
| <b>Year: I</b> | <b>DISCIPLINE CENTRIC ELECTIVE PRACTICAL 1</b>          | <b>Semester: I</b> |
| <b>Code:</b>   | <b>1. ADVANCED JAVA PROGRAMMING LAB<br/>(Practical)</b> | <b>Credits: 2</b>  |

#### 1. Basic Concepts and File Handling:

1.1. Inheritance, Polymorphism 1.2. Constructors 1.3. Interface 1.4. Package  
1.5. One Dimensional and Two Dimensional Array Manipulation 1.6. String  
Handling (Character Extraction, String Comparison, Searching String,  
Modifying a String, String Copy) 1.7. Exception (Built-in and User Defined) 1.8.  
Thread (Using Runnable Interface and Thread Class) 1.9. File management  
(File reading, Writing, Appending and Content Replacing)

#### 2. GUI, Database and Networking:

2.1. Event Handling (Keyboard and Mouse Events) 2.2. Working with Swing (  
ImageIcon, JTextField, JTextArea, JButton, JCheckBox, JRadioButton,  
JComboBox, JList, JTable) 2.3. Layout Management (The FlowLayout,  
BorderLayout, GridLayout, CardLayout) 2.4. Simple Programs of Database  
Connectivity

**Course Objectives: After completing this course, students will be able to**

1. Explore the fundamental concepts of big data analytics and big data framework.
2. Understand NoSQL database
3. Understand HDFS framework
4. Familiarize big data tools PIG & HIVE in Hadoop ecosystem.
5. Apply basic knowledge of MapReduce Architecture and Programming

**UNIT – I: INTRODUCTION TO BIG DATA :** Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Big Data classification - Business Intelligence vs. Big Data – Introduction to Big Data platform - Data warehouse and Hadoop environment – Big Data Storage, Big Data Analytics: Classification of analytics – Big Data Analytics Applications, Fundamental concepts of Big Data management and analytics - Current challenges and trends in Big Data Acquisition - Analytic scalability, Analysis versus reporting, Popular Big Data Techniques and tools.

**UNIT – II: NoSQL DATABASES** **NoSQL:** Use of NoSQL, Types of NoSQL, Advantages of NoSQL. Use of NoSQL in Industry, SQL versus NoSQL, NewSQL  
**Mongo DB:** Introduction – Features - Data types - Mongo DB Query language – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export. **Cassandra:** Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

**UNIT – III: INTRODUCTION TO BIG DATA FRAMEWORK:** Introduction to Big data framework - Introduction to Hadoop: Features – Advantages – Versions - Overview of Hadoop Ecosystems - Hadoop distributions - Hadoop vs. SQL – RDBMS vs. Hadoop - Distributed Computing Challenges - Hadoop Components – Architecture – HDFS (Hadoop Distributed File System), HDFS Daemons, Anatomy of File read, Write, Replica management Strategy, working with HDFS Commands - Processing Data with Hadoop - Map Reduce Framework. Hadoop 2 (YARN): Architecture - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystems

**UNIT – IV: HADOOP ECO SYSTEMS:** Hadoop Ecosystems: Hive – Introduction to Hive, Hive Query Language, Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Connecting to Mongo DB - Connecting to Cassandra. Hadoop environment. Frameworks: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive.

**UNIT – V: MAPREDUCE:** Introduction, Map Tasks– Grouping by key – Partitioner - Reduce Tasks – Combiners, Details of MapReduce Execution - Coping With Node Failures, Composing MapReduce for Calculations, Algorithms Using MapReduce - Matrix vector multiplication by Map Reduce. MapReduce Programming: Introduction – Developing a Map Reduce Application - How Map Reduce Works - Anatomy of a Map Reduce Job run – Failures - Job Scheduling - Shuffle and Sort – Task execution - Map Reduce Types and Formats - Map Reduce Features.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

### **Text Books**

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.
2. Raj Kamal and Preeti Saxena, “Big Data Analytics Introduction to Hadoop, Spark, and Machine- Learning”, McGraw Hill Education, 2018.

### **Reference Books**

1. Radha Shankarmani, M Vijayalakshmi, “Big Data Analytics”, Wiley Publications, first Edition 2016.
2. Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman, Mining of Massive Datasets, Copyright © 2014,
3. O'Reilly Media, Hadoop: The Definitive Guide, Third Edition.
4. DT Editorial Services, “Black Book- Big Data (Covers Hadoop 2, MapReduce, Hive, Yarn, PIG, R, Data visualization)”, Dream tech Press edition 2016.
5. Boris Lublinsky, Kevin T. Smith. Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, 2015.

### **Course Outcomes: Upon completion of the course, students will be able to:**

CO1: Learn the fundamental concepts of big data analytics.

CO2: Analyze the various NoSQL Databases.

CO3: Understand and implement Hadoop Bigdata Framework.

CO4: Successfully apply appropriate big data tools to solve actual Big Data problems.

CO5: Understand the MapReduce framework and apply MapReduce Programming in big data analysis

**Year: I**

**DISCIPLINE CENTRIC ELECTIVE PRACTICAL 1**

**Semester: I**

**Code:**

**2. BIG DATA ANALYTICS LAB  
(Practical)**

**Credits: 2**

1. Reading and writing files in HDFS
2. Word Count Application Using MapReduce
3. Finding Maximum, Minimum, and Average Values Using MapReduce
4. Log File Analysis Using MapReduce
5. Data Warehousing Operations Using Hive
  - (i) Creating Databases and Tables
  - (ii) Loading Data
6. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB
7. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB
8. Develop Pig Latin scripts to sort, group, join, project, and filter the data

**Course Objectives:** After completing this course, students will be able to:

1. Learn the various E-learning approaches, components and the types of design models of E-Learning.
2. Explore the models for E-learning courseware development and E-learning authoring tools.
3. Introduce the concepts, principles, and evolution of e-learning and digital education
4. Develop skills in designing, developing, and delivering effective online learning content
5. Explore methods for online assessment, learner engagement, and collaborative learning in virtual environments

**UNIT – I: INTRODUCTION:** Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

**UNIT – II: DESIGNING E-LEARNING COURSE CONTENT:** Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

**UNIT – III: CREATING INTERACTIVE CONTENT:** Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development – Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.

**UNIT – IV: LEARNING PLATFORMS:** Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

**UNIT – V: COURSE DELIVERY AND EVALUATION:** Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**REFERENCES:**

1. Clark, R. C. and Mayer, R. E, “eLearning and the Science of Instruction”, Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, “Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies”, Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, “Understanding the Learning Personalities of Successful Online Students”, Educause Review, 2014.
4. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O’Riley Media, 2011.
5. Madhuri Dubey, “Effective E – learning Design, Development and Delivery”, University Press, 2011.

**Course Outcomes: Upon completion of the course, students will be able to:**

CO1: Distinguish the phases of activities in the models of E-learning.

CO2: Identify appropriate instructional methods and delivery strategies.

CO3: Choose appropriate E-learning authoring tools.

CO4: Create interactive E-Learning courseware.

CO5: Evaluate and manage the E-learning courseware

**Year: I**

**GENERIC ELECTIVE COURSE 1**

**Semester: I**

**Code:**

**2. OPTIMIZATION TECHNIQUES  
(Theory)**

**Credits: 3**

**Course Objectives: After completing this course, students will be able to**

1. Understand the fundamental concepts of optimization and their importance in decision-making and resource allocation.
2. Formulate real-world problems as mathematical optimization models involving objective functions and constraints.
3. Apply linear programming techniques to solve optimization problems in engineering, business, and management.
4. Develop skills in solving Genetic algorithm.
5. Apply integer programming and dynamic programming techniques for discrete optimization problems.

**UNIT - I:** Classical Methods & Linear Programming Problems Terminology  
Introduction to Classical Methods & Linear Programming Problems Terminology:  
Design Variables - Constraints - Objective Function - Problem Formulation.  
Calculus method - Kuhn Tucker conditions - Method of Multipliers. Linear  
Programming Problem - Simplex method - Concept of Duality.

**UNIT - II:** Single Variable Optimization: Problems Optimality Criterion -  
Bracketing Method - Region Elimination Methods - Interval Halving Method -  
Fibonacci Search Method - Golden Section Method. Gradient Based Methods:  
Newton - Raphson Method - Bisection Method - Secant Method - Application to  
Root finding.

**UNIT - III:** Multivariable Optimization Algorithms Optimality: Criteria -  
Unidirectional Search. Direct Search Methods: Hooke - Jeeves pattern search  
method - Powell's Conjugate Direction Method. Gradient Based Methods:  
Cauchy's Steepest Descent Method - Newton's method - Marquardt's Method.

**UNIT - IV:** Advance Optimization Techniques: Quadratics Programming -  
sequential quadratic programming - Integer Programming - Penalty Function  
Method - Branch and Bound Method - Geometric Programming.

**UNIT - V:** Dynamic Programming: Genetic algorithm - Problem formulation and  
application in Design of continuous beam and Optimal geometric layout of a truss  
- Capacity expansion and Reservoir operation.

**UNIT - VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester  
Concerned

**Text Book(s):**

1. S. S. Rao: Engineering Optimization: Theory and Practice, New Age International, Third Edition 2013.
2. E. J. Haug and J.S. Arora, Applied Optimal Design: Mechanical and Structural Systems, Wiley, 1979.

**Reference Book(s):**

1. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India, Second Edition, 2012.
2. A. Ravindran and K.M. Ragsdell, G.V. Reklaites, Engineering Optimization: Methods and Applications, Wiley, Second Edition, 2006.

**Course Outcomes:**

After completing the course, students will be able to:

CO1: Apply mathematical and computational techniques to optimization problems.

CO2: Make data-driven decisions for efficient allocation of resources.

CO3: Model and solve real-world problems arising in industry, logistics, networking, and management.

CO4: Build a foundation for advanced studies in Operations Research, Artificial

CO5: Intelligence, Machine Learning, and Data Science.

Apply Dynamic Programming concepts

**Course Objectives: After completing this course, students will be able to:**

1. Understand the influences of digital in marketing
2. Under the marketing skills and current trends
3. Design and develop their digital marketing content

**UNIT – I: INTRODUCTION TO DIGITAL MARKETING:** Digital Marketing Introduction: Fundamentals – Importance – Traditional marketing Vs Digital Marketing – Evolution of Digital Marketing – Key Drivers – Digital Consumer & Communities – Digital Economy and Distribution – Digital marketing Strategy- Consumer Decision journey – Segmenting & Customizing messages – Skills in Digital Marketing – Digital marketing Plan – Digital users in India – Digital advertising Market in India

**UNIT – II: CONTENT CREATION, MANAGEMENT AND MARKETING TERMINOLOGY USED IN DIGITAL MARKETING:** Content Creation, Management and Marketing : Content Creation – Types –States – Management and Types – Tools – Content Marketing, Terminologies : PPC and online marketing through social media Social Media Marketing – SEO techniques – Keyword advertising – Google web-master and analytics overview – Affiliate Marketing – Email Marketing – Email Marketing Campaign – Connect Email to CRM – Mobile Marketing – Display adverting – Buying Models – different type of ad tools – Display advertising terminology – types of display ads – different ad formats – Ad placement techniques Important ad terminology –Types of Banner – Programmatic Digital Advertising.

**UNIT – III: SOCIAL MEDIA MARKETING:** Fundamentals: Fundamentals of Social Media Marketing – Importance – Necessity of Social media Marketing – Goal Setting – Implementation. Facebook Marketing: Facebook for Business – Facebook Insight – formats – Setting up Facebook Advertising Account – Facebook audience & types – Designing Facebook Advertising campaigns – Facebook Avatar – Apps – Live – Hashtags

**UNIT – IV: SOCIAL MEDIA MARKETING II:** LinkedIn: Importance – Strategy – Content – LinkedIn analysis – Targeting – Ad Campaign; Twitter: Basics – Building a content strategy – Twitter usage – Twitter Ads – Twitter ad campaigns- Twitter Analytic -Twitter Tools and tips for mangers

**UNIT – V: SOCIAL MEDIA MARKETING III:** Instagram: Content Creation – Visual Identity – Audio & Video editing – Instagram Analysis; You Tube: Content engine – setting up channel – video editing – audio editing – graphic design – video performance – YouTube Analysis

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Book(s)**

1. Vandana Ahuja, Digital Marketing, OXFORD UNIVERSITY PRESS, INDIA, 201
2. Damian Ryan (Author), Calvin Jones. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan, 2008
3. Mr. Prakash B. Narke Prof. Nitin Ka, mat , Dr. Manik S. Kadam , Dr. Abhay S. Kinikar , Mr. Pramod Jejurikar, Digital Marketing, Nirali Prakashan, 2021

**Reference Books**

1. Annmarie Hanlon, Joanna Akins, Quick Win Digital Marketing, Oak Tree Press, 2009
2. Seema Gupta, Digital Marketing, 2022

**Online Contents** [MOOC, SWAYAM, NPTEL, Websites etc.]

1. [https://www.oracle.com/ Marketing](https://www.oracle.com/Marketing)
2. <https://www.investopedia.com/terms/d/digital-marketing>

**Course Outcomes:**

Upon completion of the course, students will be able to:

CO1: Understand marketing skills

CO2: Understand Advertising Skills

CO3: Understand the current trends in digital marketing

CO4: Design and develop digital marketing content

CO5: Get a job/ freelancer in the Digital Marketing domain.

**Course Objectives: After completing this course, students will be able to**

- 1.How to represent the structure and designs using HTML and XHTML and other related web technologies.
- 2.Understand of how the internet application works and develop web programming skills.
- 3.Establish a professional, client-based attitude towards web design.
- 4.Understand server side programming for web application Development
- 5.Develop web pages with database connectivity

**UNIT – I: Introduction to Web-** Web essentials – Basics of Internet –History of the Internet and World Wide Web - Web2.0 – Technology overview – integrating with web services –Motivation and Characteristics – uses - Basic operational model of web services - core web services – Known challenges in Web Services – Building the Web Services Architecture. Technologies

**UNIT – II: Markup languages:** HTML & XHTML- Basics – Headers – Linking – Images – Frames –Frameset –Forms – Tables – CSS – simple web page designs.

**UNIT – III: Clientside Programming–** Introduction to Javascript – Control statements – Function – Basic Javascript programs.

**UNIT – IV: Server-side programming** – Server side programming basics – java servlets – simple web based applications-Session– Sessiont racking.

**UNIT – V: Database Connectivity** - Introduction to Database-Representing Web data – database connectivity – SQL/MS – Access – Dynamic Web pages – Building Web applications – cookies.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Textbooks**

1. Deitel and Deitel, “Internet and World Wide Web How to program”, Prentice Hall of India, Fourth Edition,2014.
2. Gustavo Alonso, Fabio Casati, Harumi Kuno and Vijay Machiraju, “Web services” Springer International Edition, First edition,2019.

**Course Outcomes: Upon completion of the course, students will be able to:**

- CO1: Understand the working of internet with HTML and XHTML.  
CO2: Understand the working principle of internet applications.  
CO3: Construct HTML and XHTML documents  
CO4: Develop client / server side programming for web application Development.  
CO5: Describing the relationship between client/server objects used by SQL

**Course Objectives: After completing this course, students will be able to**

1. Learn Better user interface design
2. Design the front end in effective manner
3. Explore the opportunities on the front end designer

**UNIT – I: FOUNDATIONS OF SCREEN DESIGN:** UI vs. UX Design – Core Stages of Design Thinking – Divergent and Convergent Thinking -Brainstorming and Gamestorming – Observational Empathy

**UNIT – II: FOUNDATIONS OF UI DESIGN:** Visual and UI Principles – UI Elements and Patterns – Interaction Behaviors and Principles -Branding – Style Guides

**UNIT – III: WIREFRAMING, PROTOTYPING AND TESTING:** Sketching Principles – Sketching Red Routes – Responsive Design – Wireframing – Creating Wireflows – Building a Prototype – Building High - Fidelity Mockups – Designing Efficiently with Tools – Interaction Patterns – Conducting Usability Tests – Other Evaluative User Research Methods -Synthesizing Test Findings – Prototype Iteration

**UNIT – IV: UX PROCESS AND PROJECTS:** UX Improvement Process - UX Delivery Process - UX Projects – UX Tools

**UNIT – V: RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE:** Identifying and Writing Problem Statements – Identifying Appropriate Research Methods – Creating Personas – Solution Ideation – Creating User Stories – Creating Scenarios – Flow Diagrams – Flow Mapping – Information Architecture.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Book(s)**

1. Brian Peel, UI UX Design: A Beginner's Guide to Mastering Layouts, Interactions, and User Testing, 2024
2. Don Norman, The Design of Everyday Things, Basic Publisher, 2013,

**Reference Book**

1. Irene Pereyra, Universal Principles of UX, Rockport Publisher, 2023

**Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**

1. <https://www.edureka.co/blog/ui-ux-design-tutorial/>
2. <https://developer.android.com/design/ui>
3. [https://onlinecourses.nptel.ac.in/noc21\\_ar05/](https://onlinecourses.nptel.ac.in/noc21_ar05/)

**Course Outcomes: Upon completion of the course, students will be able to:**

CO1: Understand the foundation of Screen design

CO2: Understand the foundation of user interface design

CO3: Apply user interface design

CO4: Design and develop user interface design

CO5: Understand UX tools

**Course Objectives: After completing this course, students will be able to**

1. Understand the fundamental concepts, functions, and structures of operating systems.
2. Explore process management, process scheduling, and inter-process communication
3. Analyze synchronization, deadlocks, and various methods for handling them.
4. Understand memory management techniques, including paging, segmentation, and virtual memory.
5. Develop shell scripts using variables, operators, control structures, functions, and command-line utilities.

**UNIT – I: Introduction to operating systems:-** Functions of operating system - Types of operating systems-Batch Operating System, Multi programming-Time sharing, Real time, distributed operating systems. Operating system operations- dual mode and multimode operation. System structures - Operating system services, System calls, Types of system calls, Operating system structure - Simple structure, Layered approach.

**UNIT – II: Process management** - Process concept - Process state, PCB, Process Scheduling - Scheduling queues, Schedulers, Context switch, Operations on processes - creation, termination, Interprocess Communication- Shared memory systems, Message Passing systems. Process Scheduling – Basic Concepts, Scheduling criteria , Scheduling algorithms- FCFS, SJF, Priority scheduling, RR scheduling, Multilevel queue scheduling, Multilevel Feedback queue scheduling .

**UNIT – III: Process Synchronization** - The critical section problem- Peterson's solution, Synchronization hardware, Mutex Locks, Semaphores, Monitors, Monitor usage Deadlocks – System model, Deadlock characterisation, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock

**UNIT – IV: Memory management** - Memory management strategies - Basic hardware, Address binding, Logical Vs Physical address space, Dynamic loading , Dynamic linking and shared libraries , Swapping ,Contiguous memory allocation ,segmentation , Paging - Basic method , Hardware support , Protection ,Shared pages. Virtual memory management:- Demand paging - Basic concepts, Performance of demand paging, Page Replacement, Page Replacement algorithms - FIFO, Optimal page replacement, LRU page replacement .

**UNIT – V: The Linux System** - Features, Advantages, Various types of shells available in Linux Linux Commands for files and directories - cd, ls, cp, rm, mkdir, rmdir, pwd, file, more, less. Filter commands, file processing commands. Shell programming – Basics of shell programming – shell programming in Bash, conditional and looping statements, case statement, parameter passing and arguments, shell variables, system shell variables, shell keywords, creating shell programs for automating system task.

**UNIT – VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester Concerned

**Text Books**

1. Abraham Silberschatz, Galvin, Gange, Operating System Concepts, - 9th edition, Wiley Publishers .
2. Milan Milenkovic, Operating Systems, Second Edition.
3. Official Red hat Linux Users Guide- Red hat, Wiley Dreamtech India.

**Reference Books**

1. Christopher Negus - Red Hat Linux Bible - 2005 Edition, Wiley Dreamtech India.
2. Yeswant Kanethkar - Unix Shell Programming -First Edition, BPB .

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Explain the fundamental concepts, functions, structures, and services of operating systems.

CO2: Analyze process management, CPU scheduling, process synchronization, and inter-process communication techniques.

CO3: Analyze deadlocks, protection, and security mechanisms and apply appropriate techniques for their prevention, avoidance, and detection.

CO4: Apply memory management, virtual memory, file management, and storage management concepts to solve operating system problems.

CO5: Write shell scripts using commands, variables, operators, control structures, functions, and other shell programming features

**Course Objectives: After completing this course, students will be able to**

1. Introduce the fundamental syntax and structure of C# programming.
2. Develop proficiency in object-oriented programming concepts using C#.
3. Explore data structures and collections provided by .NET.
4. Understand exception handling, delegates, events, and lambda expressions.
5. Apply LINQ for querying data collections in an efficient and expressive manner.

**UNIT – I: INTRODUCTION TO C#:** C# Defining features – C# standards and implementation – Anatomy of simple program. Variables and Operators: Scope of local variables – Statements and Expressions – Comments and Whitespace – Preprocessing Directives – Fundamental data Types – Operators – Flow Control – Patterns.

**UNIT – II: TYPES AND COLLECTIONS:** Types: Classes – Structs – Members – Interfaces – Enums – Other Types – Partial types and Methods. Collections: Arrays – List and Sequence Interfaces – Implementing Lists and Sequences – Addressing Elements with Index and Range Index – Directories – Sets – Queues and Stacks – Linked Lists – Concurrent Collections – Immutable Collections.

**UNIT – III: INHERITANCE AND OBJECT LIFETIME:** Inheritance: Inheritance and Conversions – Interface Inheritance – Generics – System. Object – Accessibility and Inheritance – Virtual Methods – Sealed Methods and Classes – Accessing Base Members – Inheritance and Construction – Special Base Types. Object Lifetime: Garbage Collection – Destructors and Finalization – Disposable – Boxing.

**UNIT – IV: EXCEPTIONS, DELEGATES, LAMBDA, AND EVENTS:** Exceptions: Exception Sources – Handling Exceptions – Throwing Exceptions – Exception Types – Unhandled Exceptions. Delegates, Lambdas, and Events: Delegate Types – Anonymous Functions – Events – Delegates Versus Interfaces.

**UNIT – V: LINQ:** LINQ: Query Expressions – Deferred Evaluation – LINQ, Generics and IQueryable – Standard LINQ Operators – Sequence Generation – Other LINQ Implementations.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Book(s)**

1. Ian Griffiths, “Programming C# 8.0 Build Cloud, Web, and Desktop Applications”, O’Reilly. 2020
2. Andrew Stellman and Jennifer Greene, Head First C#, 5th Edition, O’Reilly Media, 2024.
3. Joseph Albahari and Ben Albahari, C# 12 in a Nutshell: The Definitive Reference, 1st Edition, O’Reilly Media, 2024.

**Reference Books**

1. Mastering\_Visual\_C#\_.NET by Jason Price, Mike Gunderloy

**Online Contents** [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Advanced Diploma in .NET Technologies by National Institute of Electronics & Information Technology, Calicut  
<https://www.nielit.gov.in/calicut/index.php>

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Understand and apply basic C# syntax, data types, operators, and control structures to create simple programs.

CO2: Implement and use advanced C# types such as classes, structs, interfaces, and various built-in collections effectively.

CO3: Apply object-oriented principles including inheritance, generics, and object lifetime management in software development.

CO4: Handle runtime anomalies using exception handling techniques and utilize delegates, lambdas, and events for flexible program design.

CO5: Use LINQ to perform efficient data querying and manipulation with various data sources.

1. Write a program to find the factorial, prime numbers, and Fibonacci series.
2. Create a class for a Bank Account with deposit and withdraw methods using encapsulation.
3. Implement method overloading and method overriding with shapes.
4. Demonstrate interface implementation and abstract classes for an employee payroll system.
5. Handle divide-by-zero and null reference exceptions using custom exception classes.
6. Create a generic class to implement a stack and a queue data structure.
7. Use delegates and events to implement a simple notification system.
8. Write LINQ queries to sort, filter, and group a collection of student objects.
9. Design a login form with validation controls in Windows Forms.
10. Create a simple calculator app using button events and grid layouts.
11. Connect a C# application to a SQL Server database using ADO.NET

**Course Objectives: After completing this course, students will be able to:**

1. Understand the concepts of Machine Learning.
2. Understand complexity of Machine Learning algorithms and their limitations.
3. Understand various features of Python language.
4. Implement various packages of python library.
5. Perform experiments in machine learning on real-world data using python.

**UNIT – I: Introduction to Python:** Installing python, Data types, Basic operators, Strings, Lists, Tuple, Sets, Dictionary, Control structures, Functions, Modules, File Input/Output, Exception handling.

**UNIT – II: Introduction to Machine Learning** - Introduction, Types of machine learning: supervised, unsupervised, semi-supervised reinforcement learning, Batch learning and Online learning, Machine learning model, Steps in the design of learning system, Challenges in machine learning, Applications of machine learning. Machine learning python packages: NumPy, Pandas, Matplotlib, Scikit Learn

**UNIT – III: Classification-** Labelled data, Introduction to classification and its types, Statistical summary of data, Data preprocessing, Normalization, Training and Testing, Cross Validation, Steps in building a classifier in python. Classification algorithms: K-nearest neighbor, Support vector machine, Decision tree, Classification evaluation metrics etc.,

**UNIT – IV: Feature Selection and Clustering** Feature Selection: Introduction and its importance, Feature selection techniques, Principal component analysis. Unlabeled data, Introduction to clustering and its applications, Cluster formation methods, means algorithm, Hierarchical clustering, etc.

**UNIT – V: Model Diagnosis and Tuning** - Overfitting, Underfitting, Bias and Variance, Imbalanced dataset and its handling, Hyperparameter tuning, Ensemble methods: Bagging and Boosting, Ensemble voting.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Manohar Swamynathan "Mastering Machine Learning with Python in Six Steps", Apress, ISBN-13 (pbk): 978-1-4842-2865-4, ISBN-13 (electronic): 978-1-4842-2866-1
2. Machine Learning, "A Probabilistic Perspective", MIT Press, 2012 by Kevin Murphy. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms".

**References:**

1. Mark Summerfield, "Programming in python: A Complete Introduction to Python Programming". Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners",2009.

**Web Resources:**

1. [https://www.tutorialspoint.com/machine\\_learning\\_with\\_python/index.htm](https://www.tutorialspoint.com/machine_learning_with_python/index.htm)
2. <https://www.tutorialspoint.com/python/index.htm>

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Demonstrate proficiency in advanced Python programming concepts, including modules, packages, decorators, generators, iterators, and exception handling.

CO2: Design and develop efficient, modular, and reusable Python applications using object-oriented programming principles.

CO3: Apply advanced data structures, file handling techniques, and regular expressions to solve complex computational problems.

CO4: Utilize Python libraries and frameworks for data processing, scientific computing, and automation tasks.

CO5: Implement data analysis and visualization solutions using popular Python libraries such as NumPy, Pandas, and Matplotlib.

|                |                                                           |                     |
|----------------|-----------------------------------------------------------|---------------------|
| <b>Year: I</b> | <b>DISCIPLINE CENTRIC ELECTIVE PRACTICAL 2</b>            | <b>Semester: II</b> |
| <b>Code:</b>   | <b>1. ADVANCED PYTHON PROGRAMMING LAB<br/>(Practical)</b> | <b>Credits: 2</b>   |

1. Perform data preprocessing tasks such as handling missing values, encoding categorical variables, and scaling numerical features. Visualize data distributions, correlations, and relationships using Pandas and Matplotlib libraries.
2. Implement a simple linear regression model using scikit-learn to predict a continuous target variable. Visualize the regression line and residuals to assess model performance.
3. Implement and compare different classification algorithms (e.g., logistic regression, KNN, decision trees) using scikit-learn.
4. Apply the K-Means clustering algorithm to group data points into clusters based on similarity. Visualize clusters and centroids to interpret clustering results.
5. Perform dimensionality reduction using Principal Component Analysis (PCA) to reduce the number of features in a dataset.
6. Implement a Support Vector Machine (SVM) classifier for both linear and non-linear datasets.
7. Build and train a simple artificial neural network (ANN) using Keras and TensorFlow backend.
8. Implement a Convolutional Neural Network (CNN) architecture using Keras for image classification tasks (e.g., MNIST, CIFAR-10).
9. Evaluate CNN performance on test data and visualize feature maps and filters.

**Course Objectives: After completing this course, students will be able to:**

1. Understand basic approaches to NLP
2. Analyze the text representation
3. Get knowledge about text classification
4. Build the Chatbots
5. Understand the topic modeling

**UNIT – I: INTRODUCTION TO NLP and NLP Pipeline:** Introduction to NLP, Applications of NLP. Basic approaches to NLP -Heuristics based NLP, Machine Learning for NLP, Deep Learning for NLP. NLP Pipeline- Data Acquisition, Text Extraction and Cleanup, Pre-processing, Feature Engineering, Building the model, Evaluation.

**UNIT – II: TEXT REPRESENTATION:** Vector space models, Basic Vectorization approaches, Distributed representations, Universal Text Representations. Search and Information Retrieval- Components of Search Engine.

**UNIT – III: TEXT CLASSIFICATION:** Pipeline for building Text classification systems, One pipeline-many classifiers, Using Neural Embeddings in Text Classification, Deep Learning for Text Classification, Learning with no or less data and adapting to new domains.

**UNIT – IV: INFORMATION EXTRACTION and CHATBOTS:** Information Extraction-IE Applications, IE Tasks, General IE Pipeline, Key-Phrase Extraction, Named Entity Recognition, Building an NER System, Relationship Extraction. Chatbots- Applications, Taxonomy of Chatbots, Pipeline for building Dialog Systems

**UNIT – V: Topic Modeling:** Text Summarization, Recommender Systems, Machine Translation, Question Answering Systems. NLP for Social Media Data, e-commerce Catalog, Review Analysis

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**TEXTBOOKS:**

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta and Harshit Surana, “Practical Natural Language Processing”, O’Reilly Media Inc., 2021, ISBN: 978-93-8588-918-9.

**REFERENCE BOOKS:**

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition, 2009.

2. C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA, 1999.
3. James Allen, “Natural Language Understanding”, The Benjamin/Cummings Publishing Company Inc.
4. Toolkit Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python – Analyzing Text with the Natural Language”, 1st Edition, 2009.

**WEB REFERENCES:**

1. [https://www.tutorialspoint.com/natural\\_language\\_processing/natural\\_language\\_processing\\_tutorial.pdf](https://www.tutorialspoint.com/natural_language_processing/natural_language_processing_tutorial.pdf)
2. <http://www.nptelvideos.in/2012/11/natural-languageprocessing.html>

**Course Outcome: Upon completion of the course, students will be able to:**

- CO1: Understand the basic concepts of NLP and NLP-Pipeline.  
CO2: Understand the Text Representation and Search Engine.  
CO3: Apply the Text Classification Techniques.  
CO4: Use of Information Extraction and Chatbots.  
CO5: Analyze various applications of NLP.

|                |                                                           |                     |
|----------------|-----------------------------------------------------------|---------------------|
| <b>Year: I</b> | <b>DISCIPLINE CENTRIC ELECTIVE PRACTICAL 2</b>            | <b>Semester: II</b> |
| <b>Code:</b>   | <b>2. NATURAL LANGUAGE PROCESSING LAB<br/>(Practical)</b> | <b>Credits: 2</b>   |

1. Write a program in Python to collect text data using Twitter APIs.
2. Write a program in Python to extract text from PDF file and store it for further analysis.
3. Write a program in Python to read parse/read HTML pages.
4. Write a program in Python for
  - (i) Standardizing the Text (ii) Tokenizing the Text
  - (iii) Stemming the Text (iv) Lemmatizing the Text
5. Write a program in Python to replace an emoji with a relevant, meaningful word.
6. Write a program in Python to remove emoticons.
7. Write a program in Python to generate the n-grams for a given sentence.
8. Write a program in Python to convert text to features.
9. Write a program in Python to find the similarity between two texts.
10. Write a program in Python to do a sentiment analysis.

**1. ORGANISATIONAL BEHAVIOUR AND HUMAN  
RESOURCE MANAGEMENT  
(Theory)**

**Course Objectives: After completing this course, students will be able to**

1. Understand the factors that influence individual behaviour
2. Analyse the significance and process of change management in organisations
3. Understand the importance of Human Resource planning and its process
4. Differentiate between traditional and modern methods of performance appraisal
5. Examine the emerging trends in compensation management

**UNIT – I: Introduction to Organisational Behaviour:** Meaning and scope of organisational behaviour - Challenges and Opportunities – Foundations of Individual behaviour, Motivation - Theories (Maslow, ERG, Douglas McGregor two-factor theory), Group dynamics, Leaderships styles

**UNIT – II: Organisational Conflict and Change:** Organizational Conflict - causes and consequences - conflict and negotiation, Organizational change, change management process, resistance to change, flexibility and crisis management – Organisational Development – concept and significance

**UNIT – III: Introduction to Human Resource Management:** HRM: Meaning, definition and functions. Job Analysis, Job Design, Human Resource Planning - Recruitment and Selection - Sources of Recruitment - Selection process, Placement and Induction

**UNIT – IV: Human Resource Development:** Introduction to Human Resource Development: Concepts - Training and Development - methods of training, importance of Performance Appraisal, traditional and modern methods of performance appraisal, Job Evaluation - methods of Job Evaluation, Wage and Salary Administration

**UNIT – V: Compensation Management, Industrial Relations and Emerging HR Practices:** Compensation – Concepts and Principles, Influencing Factors, Emerging Trends in Compensation – Methods of Payment – Incentives and Rewards, Managing Industrial Relations – Emerging trends and practices in human resource management

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**TEXT BOOKS**

1. K. Aswathappa, Organizational Behaviour, 12th edition, Himalaya, 2016
2. Edwin B. Flippo, Personnel Management, 6th edition, TMH, 2013
3. P. Subba Rao, Management & Organizational Behavior, 2nd edition, Himalaya, 2014

4. C.B. Mamoria & VSP Rao, Personnel Management, 20th edition, Himalaya, 2015
5. Stephen P. Robins, Organisational Behaviour, 11th edition, PHI Learning / Pearson Education, 2008

## **REFERENCES**

1. Rustum S. Davar, Personnel Management & Industrial Relations, 10th edition, Vikas Publishers, 2009
2. K. Venkataratnam, Human Resource Management, 1st edition, Seven hills Book Publications, 2011
3. K. Aswathappa, Human Resource & pe Management, 6th edition, Tata McGraw Hill, 2010
4. Mc Shane & Von Glinov, Organisational Behaviour, 4th edition, Tata Mc Graw Hill, 2007

## **Course Outcomes: Upon completion of the course, students will be able to:**

- CO1: To define and explain the basic concepts of organizational behaviour and motivation.
- CO2: To explain the essential concepts of organisational conflicts, resolution of conflicts through negotiation, change management and organisational development.
- CO3: To familiarize the various aspects of HR, to deal effectively with people resourcing and talent management and HR functions in an organization.
- CO4: To understand the concepts of HRD, its role and importance in the success of organization.
- CO5: To develop an understanding towards compensation management and industrial relations.

**Course Objectives: After completing this course, students will be able to:**

1. Understand the design thinking fundamental concepts
2. Know about different phases of Design Thinking
3. Apply theoretical knowledge to Design thinking
4. Formulate Design Thinking Methods
5. Design Prototype Exploration map

**UNIT – I: Introduction To Design Thinking:** Introduction to Design Thinking for Engineers, Essential Design Thinking Skills, Core Principles of Design Thinking, Foundations of Design Thinking, Building an Effective Design Thinking Team, Discussion of Problems from IT sector.

**UNIT – II: Design Thinking Phases:** Stages of Design Thinking, Role of observation in understanding product and process challenges, Preparation of AEIOU and other canvases with defined problem statement, Exploring Design Thinking in Innovation- Understanding the Role of Design Thinking in Product and Process Innovation, Differentiating Engineering Design and Design Thinking, Double Diamond model and its application.

**UNIT – III: Design Thinking Techniques:** Understanding, Listening and Empathizing Techniques, Exploring observation methods, Utilizing a structured, open-ended approach for effective communication, Ideation Tools, Brainstorming techniques for idea generation, Applying innovation to foster creativity, Application of SCAMPER Technique to an approved Problem Statement; Prototyping- Creating low-fidelity and high-fidelity prototypes, Testing of Prototype.

**UNIT – IV: Design Thinking Methods:** Methods and Tools for Design Thinking Practice; Empathize: Ask five why questions, Empathy map, storytelling, critical items diagram, mind map, journey map; Ideate: Brainstorming, 2X2 matrix, Need Approach-Benefit-Competition (NABC) Methods;

**UNIT – V: Prototype Exploration map:** Minimum Viable Product (MVP), Feasibility Testing, Viability Testing, A/B Testing, Sustainability Testing, Collect Feedback, Iterate and Improve the ideas; PDC canvas verification.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books**

1. Soni, Pavan. Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving. Penguin Random House India Private Limited, 2020.
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins e-books (2009).

3. Liedtka, Jeanne, Randy Salzman, and Daisy Azer. Design thinking for the greater good: Innovation in the social sector. Columbia University Press, 2019.
4. Lockwood, Thomas. Design thinking: Integrating innovation, customer experience, and brand value. Simon and Schuster, Allworth Press, 2010.

**Course Outcomes:** Upon successful completion of the course, students will be able to:

CO1: Understand the fundamental principles and importance of Design Thinking in fostering innovation, ethics and its relevance in engineering.

CO2: Apply systematic problem identification, problem framing, articulation, and problem-solving approaches in the context of Design Thinking.

CO3: Analyze and evaluate different tools and methodologies used in Design Thinking, such as observation, ethnographic research and mind mapping to gain insights into users' needs.

CO4: Develop and refine product concepts by preparing product development canvases (PDC) that consider product experience, functions, features, and sustainable development of the components.

CO5: Create a final working prototype for projects with limitations, documenting the Functionality and Features, Viability, Impact, Sustainability, Scalability, Cost and Resource Utilization for the product

**Course Objectives: After completing this course, students will be able to**

1. Understand the fundamentals of Statistics
2. Create, organize, and manage datasets in SPSS, including defining variables, coding data, and importing data from different sources.
3. Apply Descriptive Statistics in SPSS.
4. Understand Probabilities and Sampling
5. Explore ANOVA.

**UNIT – I: Introduction:** Statistics, Descriptive vs Inferential Data Analysis, Measuring Variables, validity, reliability, explicability, Types of Variables (nominal, ordinal, interval), Common Terms-dataset, population sample, parameter, statistic, Misuses of Data examples, Univariate Descriptive Statistics, Sample Size, Range, Frequency Distributions, Histograms, Other Charts, Measures of Central Tendency and Dispersion, Means, medians, modes, Variance, standard deviation.

**UNIT – II: Introduction to SPSS for Windows:** SPSS versions, Starting an SPSS Session, critical issues - SPSS: general description, functions, menus, commands, SPSS file management, Types of Data, Structuring your data for use in SPSS, Creating a New Dataset, Using an Existing Dataset, Manipulating and Merging Datasets, Importing and Exporting Data, Printing Datasets, Data manipulation - Data Transformation - Syntax files and scripts - Output management

**UNIT – III: Descriptive Statistics in SPSS-** More on different types of data - mean, standard deviation, variance, range, frequencies, Manipulating Data in SPSS, Recoding and Transforming Variables, Graphs and Charts, Scatter plots, Histograms, Box Plots and Other Charts, Cross-tabulations, Printing and Saving Output

**UNIT – IV: Probabilities and Sampling:** Binomial and Normal Random Variables, Z-scores, Using the Normal Table, Other distributions ,Methods of Sampling ,Systematic Sampling, Random Sampling ,Sampling Error.

**UNIT – V: Statistical tests** - Means - The Chi-Square Test - Cross-tabulation- T-test - Analysis of Variance - one-way ANOVA, Repeated measures ANOVA - Non parametric tests - Normality tests- Correlation and regression - Linear correlation and regression - Cronbach's Alpha - Multiple regression (linear)- Multivariate analysis - Factor analysis - Cluster analysis.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**TEXT BOOKS:**

1. Field A., Discovering Statistics Using SPSS, Fourth Edition, SAGE, 2013
2. SPSS: Stats Practically Short and Simple, first edition, Sidney Tyrrell, 2009
3. Sabine Landau and Brian S. Everitt., A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press LLC, 2004.

**REFERENCE BOOKS:**

1. Statistical Data Analysis (Oxford Science Publications) by Glen Cowan
2. Applied Statistical Analysis by IBM ICE Publication

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Understand basic statistics

CO2: Explore SPSS

CO3: Apply Descriptive Statistics

CO4: Understand Probabilities and Sampling techniques

CO5: Explore Statistical tests

**Course Objectives: After completing this course, students will be able to:**

1. Develop communicative competence among the Students.
2. Enhance the learner's soft skills by giving adequate exposure in LSRW and sub skills.
3. Apply Interpersonal skills
4. Develop Corporate skills
5. Enable learners to put the life skills into practice with confidence.

**UNIT – I: KNOW THYSELF / UNDERSTANDING SELF:** Introduction to Soft skills-Self discovery - Developing positive attitude-Improving perceptions-Forming values.

**UNIT – II: INTERPERSONAL SKILLS/ UNDERSTANDING OTHERS:** Developing interpersonal relationship-Team building-group dynamics-Net working- Improved work relationship

**UNIT – III: COMMUNICATION SKILLS / COMMUNICATION WITH OTHERS:** Art of listening –Art of reading –Art of speaking –Art of writing-Art of writing e-mails e mail etiquette.

**UNIT – IV: CORPORATE SKILLS / WORKING WITH OTHERS:** Oral Presentation – Memos- Note taking - Note making and preparing Minutes- Reports, Proposals, Abstracts - Technical Writing.

**UNIT – V: SELLING SELF / JOB HUNTING** Writing resume/cv-interview skills- Group discussion- Mock interview-Mock GD – Goal setting - Career planning

**UNIT– VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Meena.K and V.Ayothi (2013) A Book on Development of Soft Skills (Soft Skills : A Road Map to Success), P.R. Publishers
2. N. Krishnasamy, Manju Dhariwel and Lalitha Krishnasamy(2015). Mastering Communication Skills and Soft Skills – Bloomburg.
3. Meera Banerjee and Krishna Mohan: Developing Communication Skills, Trinity Publishers- (Lakshmi Publications.
4. Alex K. (2012) Soft Skills – Know Yourself & Know the World, S.Chand & Company LTD, Ram Nagar, New Delhi- 110 055.

**COURSE OUTCOMES:**

Upon successful completion of this Course, the student will be able to

CO1: Develop listening, speaking, reading and writing skills in English. □

CO2: Enhance soft skills and engage in a range of communicative tasks and activities

CO3: Comprehend a text and identify specific and global information □

CO4: Promote communicative ability in both spoken and written form of the language

CO5: Develop corporate skills to promote leadership qualities and team spirit

**Course Objectives: After completing this course, students will be able to**

1. Understand the influences of digital in marketing
2. Under the marketing skills and current trends
3. Design and develop their digital marketing content

**UNIT – I: INTRODUCTION TO DIGITAL MARKETING:**

Digital Marketing Introduction: Fundamentals – Importance – Traditional marketing Vs Digital Marketing – Evolution of Digital Marketing – Key Drivers – Digital Consumer & Communities – Digital Economy and Distribution – Digital marketing Strategy- Consumer Decision journey – Segmenting & Customizing messages – Skills in Digital Marketing – Digital marketing Plan – Digital users in India – Digital advertising Market in India

**UNIT – II: CONTENT CREATION, MANAGEMENT AND MARKETING TERMINOLOGY USED IN DIGITAL MARKETING:**

Content Creation, Management and Marketing : Content Creation – Types –States – Management and Types – Tools – Content Marketing, Terminologies : PPC and online marketing through social media Social Media Marketing – SEO techniques – Keyword advertising – Google web-master and analytics overview – Affiliate Marketing – Email Marketing – Email Marketing Campaign – Connect Email to CRM – Mobile Marketing – Display adverting – Buying Models – different type of ad tools – Display advertising terminology – types of display ads – different ad formats – Ad placement techniques Important ad terminology –Types of Banner – Programmatic Digital Advertising.

**UNIT – III: SOCIAL MEDIA MARKETING:**

Fundamentals: Fundamentals of Social Media Marketing – Importance – Necessity of Social media Marketing – Goal Setting – Implementation. Facebook Marketing: Facebook for Business – Facebook Insight – formats – Setting up Facebook Advertising Account – Facebook audience & types – Designing Facebook Advertising campaigns – Facebook Avatar – Apps – Live – Hashtags

**UNIT – IV: SOCIAL MEDIA MARKETING II:**

LinkedIn: Importance – Strategy – Content – LinkedIn analysis – Targeting – Ad Campaign; Twitter: Basics – Building a content strategy – Twitter usage – Twitter Ads – Twitter ad campaigns- Twitter Analytic -Twitter Tools and tips for mangers

**UNIT – V: SOCIAL MEDIA MARKETING III:**

Instagram: Content Creation – Visual Identity – Audio & Video editing – Instagram Analysis; You Tube: Content engine – setting up channel – video editing – audio editing – graphic design – video performance – YouTube Analysis

**UNIT – VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester Concerned

**Text Book(s)**

1. Vandana Ahuja, Digital Marketing, OXFORD UNIVERSITY PRESS, INDIA, 201
2. Damian Ryan (Author), Calvin Jones. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan, 2008
3. Mr. Prakash B. Narke Prof. Nitin Ka, mat , Dr. Manik S. Kadam , Dr. Abhay S. Kinikar , Mr. Pramod Jejurikar, Digital Marketing, Nirali Prakashan, 2021

**Reference Books**

1. Annmarie Hanlon, Joanna Akins, Quick Win Digital Marketing, Oak Tree Press, 2009
2. Seema Gupta, Digital Marketing, 2022

**Related Online Contents** [MOOC, SWAYAM, NPTEL, Websites etc.]

1. [https://www.oracle.com/ Marketing](https://www.oracle.com/Marketing)
2. <https://www.investopedia.com/terms/d/digital-marketing>

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Understand marketing skills

CO2: Understand Advertising Skills

CO3: Understand the current trends in digital marketing

CO4: Design and develop digital marketing content

CO5: Explore Digital Marketing domain

**Code:** **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Theory)** **Credits: 4**

**Course Objectives: After completing this course, students will be able to**

1. Understand the fundamentals of Artificial Intelligence and its core problem-solving techniques using intelligent agents, search strategies, and logic-based reasoning.
2. Comprehend the theoretical foundations and algorithmic frameworks of machine learning, with an emphasis on supervised and unsupervised learning methodologies.

**UNIT – I: Problem Solving and Knowledge Representation:** Solving problems by searching – adversarial search – constraint satisfaction problems – Logical agents – Propositional logic – First order logic – Forward chaining – Backward chaining – Ontological Representations and Reasoning Systems.

**UNIT – II: Uncertain Knowledge and Reasoning:** Overview of uncertainty and basic probability – Baye’s rule – Bayesian networks – Hidden Markov models – Kalman filters – Utility Functions – Decision Networks – Sequential decision problems – Game theory

**UNIT – III: Machine Learning Introduction:** Types of learning – Hypothesis space – Inductive bias – Evaluation – Cross validation – Bias variance – Bias Variance Trade off. Activities: Develop a simple Intelligent Agent that uses logical reasoning to infer hidden facts or constraints

**UNIT – IV: Supervised Learning:** Linear Regression – Logistic Regression – Decision trees: Classification and regression trees – Neural networks, multilayer perceptron – Support vector machines: linear and non-linear kernel functions – K nearest neighbours – Ensemble learning: bagging and boosting.

**UNIT – V: Unsupervised and Probabilistic Learning:** Clustering: partition, hierarchical and density based clustering – Self organizing maps – Expectation maximization – Gaussian mixture models – Principal component analysis – Bayesian learning: Bayes optimal classifier, Naïve Bayes classifier, Bayesian belief networks.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Stuart Russell and Peter Norvig Artificial Intelligence - A Modern Approach, Prentice Hall, 3rd edition, 2011.
2. Elaine Rich, Kevin Knight and Shiv Shankar B. Nair, Artificial Intelligence, 3rd edition, Tata McGraw Hill, 2009.
3. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997.
4. References:

5. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
6. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.

**E-resources:**

1. Nptel Course, An Introduction to Artificial Intelligence by Prof Mausam
2. Nptel Course, Machine Learning, By Prof. Carl Gustaf Jansson

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, scope, and applications of artificial intelligence and machine learning in solving real-world problems.

CO2: Analyze various artificial intelligence and machine learning models to understand their behavior, performance, and suitability for different problem domains.

CO3: Evaluate machine learning algorithms and artificial intelligence techniques based on accuracy, efficiency, and applicability to specific use cases.

CO4: Design intelligent systems by selecting and integrating appropriate machine learning models and AI techniques to address complex real-world applications.

CO5: Explore Clustering techniques

**Course Objectives:** After completing this course, students will be able to:

1. Identify the differences between Quantum Computing and conventional computing
2. Understand the different quantum computing mechanics.
3. Know the in depth of quantum computation theory.
4. Understand Quantum algorithms, and their advantages over classical algorithms.
5. Get the knowledge about quantum cryptography

**UNIT – I: INTRODUCTION OF QUANTUM COMPUTING AND OVERVIEW :**

History of quantum computation and quantum information, Quantum bits, Multiple qubits, Quantum computation, Single qubit gates, Multiple qubit gates, Measurements in bases other than the computational basis, Quantum circuits, Qubit copying circuit.

**UNIT – II: Quantum Circuits:** Quantum Algorithms – Classical computations on a quantum computer, Quantum parallelism, Deutsch's algorithm, The Deutsch-Jozsa algorithm-Universal Quantum Gates – Quantum Circuit Model of Computation – Simulation – Quantum Fourier Transform and Applications – Quantum Search Algorithms – Quantum Computers.

**UNIT – III: QUANTUM INFORMATION** - Quantum Noise and Quantum Operations: Classical Noise and Markov processes – Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entrop.

**UNIT – IV: QUANTUM ERROR-CORRECTION** - The three-qubit bit flip code, the Three-qubit phase flip code, The Shor code, the Theory of quantum error correction Discretization of the errors, Independent error models, Degenerate codes, The quantum Hamming bound.

**UNIT – V: QUANTUM CRYPTOGRAPHY:** Private key cryptography, Privacy amplification and information reconciliation, Quantum key distribution, Privacy, and coherent information, and security of quantum key distribution.

**UNIT – VI: Current Contours (For continuous internal assessment only):** Contemporary Developments Related to the Course during the Semester Concerned

**TEXT BOOKS:**

1. Nielsen and Chuang, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010.
2. Wong, H. Y. (2024). Introduction to quantum computing: From a layperson to a programmer in 30 steps (2nd ed.)

**REFERENCE BOOKS:**

- 1.Scott Aaronson, “Quantum Computing since Democritus”, Cambridge, 2013.
- 2.Riley Tipton Perry, “Quantum Computing from the Ground Up”, World Scientific Publishing Ltd 2012.
3. V.K Sahni, Quantum Computing (with CD), TATA McGraw-Hill, 2007.
4. Thapliyal, H., & Humble, T. (Eds.). (2024). Quantum computing: Circuits, systems, automation and applications
5. Hidary, J. D. (2021). Quantum computing: An applied approach (2nd ed.).

**WEB REFERENCES:**

1. <https://fivebooks.com/best-books/quantum-computing-chris-bernhardt/>
2. <https://philpapers.org/browse/quantum-computation>
3. [https://link.springer.com/referenceworkentry/10.1007/978-1-4020-8265-8\\_1230](https://link.springer.com/referenceworkentry/10.1007/978-1-4020-8265-8_1230)
4. <https://www.fi.muni.cz/usr/gruska/qbook1.pdf>
5. <https://library.oapen.org/handle/20.500.12657/48236>
6. <https://freecomputerbooks.com/Quantum-Computing-for-the-Quantum-Curious.html>
7. [https://www.open.edu/openlearn/science-maths-technology/introduction-quantum-computing?utm\\_source=chatgpt.com](https://www.open.edu/openlearn/science-maths-technology/introduction-quantum-computing?utm_source=chatgpt.com)
8. [https://www.researchgate.net/publication/329818131\\_Open\\_source\\_software\\_in\\_quantum\\_computing?utm\\_source=chatgpt.com](https://www.researchgate.net/publication/329818131_Open_source_software_in_quantum_computing?utm_source=chatgpt.com)
9. [https://www.reddit.com/r/opensource/comments/1k2cr9e/?utm\\_source=chatgpt.com](https://www.reddit.com/r/opensource/comments/1k2cr9e/?utm_source=chatgpt.com)

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Analyze the performance of data transmission between the systems using quantum computing algorithms.

CO2: Identify suitable technique to minimize complexity of different computational problems.

CO3: Apply quantum search algorithms of find quantum information for speeding up the solutions of NP-complete problems.

CO4: Apply three-qubit phase flip code & shor code to discretize and correct the errors.

CO5: Identify suitable cryptography algorithms to provide security for quantum information

**List of Practicals:**

1. Demonstrate basic problem-solving using Breadth-First Search on a simple grid.
2. Implement Depth-First Search (DFS) on a small graph.
3. Solve the Water Jug Problem using Breadth First Search (BFS).
4. Implement a Hill Climbing search to find the peak in a numeric dataset.
5. Apply the A\* Search algorithm to find the shortest path in a 4x4 grid.
6. Implement the Minmax search algorithm for 2-player games.
7. Implement linear regression using python.
8. Implement Naïve Bayes theorem to classify the English text
9. Implement k-nearest neighbors classification using python
10. Implement Support Vector Machine

Code:

**1. FULL STACK DEVELOPMENT  
(Theory)**

Credits: 4

**Course Objectives: After completing this course, students will be able to:**

1. Familiar to implement fast, efficient, interactive and scalable web applications using run time environment provided by the full stack components.
2. Understand the working principles of Node.js
3. Develop problem-solving skills in MongoDB
4. Demonstrate the use of Angular application
5. Analyze and interpret the React components.

**UNIT – I: Introduction to Full Stack Development:** Understanding the Basic Web Development Framework- User, Browser, Webserver, Backend Services, Full Stack Components - Node.js, MongoDB, Express, React, Angular. Java Script Fundamentals, NodeJS- Understanding Node.js, Installing Node.js, Working with Node Packages, creating a Node.js Application, Understanding the Node.js Event Model, Adding Work to the Event Queue, Implementing Callbacks

**UNIT – II: Node.js:** Working with JSON, Using the Buffer Module to Buffer Data, Using the Stream Module to Stream Data, Accessing the File System from Node.js- Opening, Closing, Writing, Reading Files and other File System Tasks. Implementing HTTP Services in Node.js- Processing URLs, Processing Query Strings and Form Parameters, Understanding Request, Response, and Server Objects, Implementing HTTP Clients and Servers in Node.js, Implementing HTTPS Servers and Clients. Using Additional Node.js Modules-Using the os Module, Using the util Module, Using the dns Module, Using the crypto Module.

**UNIT – III: MongoDB:** Need of NoSQL, Understanding MongoDB, MongoDB Data Types, Planning Your Data Model, Building the MongoDB Environment, Administering User Accounts, Configuring Access Control, Administering Databases, Managing Collections, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Understanding the Objects Used in the MongoDB Node.js Driver, Accessing and Manipulating Databases, Accessing and Manipulating Collections

**UNIT – IV: Express and Angular:** Getting Started with Express, Configuring Routes, Using Requests Objects, Using Response Objects. Angular: importance of Angular, Understanding Angular, creating a Basic Angular Application, Angular Components, Expressions, Data Binding, Built-in Directives, Custom Directives, Implementing Angular Services in Web Applications.

**UNIT – V: React:** Need of React, Simple React Structure, The Virtual DOM, React Components, Introducing React Components, Creating Components in React, Data and Data Flow in React, Rendering and Life Cycle Methods in React, Working with forms in React, integrating third party libraries, Routing in React.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**TEXT BOOKS:**

1. Brad Dayley, Brendan Dayley, Caleb Dayley., Node.js, MongoDB and Angular Web Development, 2nd Edition, Addison-Wesley, 2019.
2. Mark Tielens Thomas, React in Action, 1st Edition, Manning Publications.

**REFERENCE BOOKS:**

1. Vasan Subramanian, Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, 2nd Edition, Apress, 2019.
2. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', 1st edition, Apress, 2018.
3. Kirupa Chinnathambi, Learning React: A Hands-On Guide to Building Web Applications Using React and Redux, 2nd edition, Addison-Wesley Professional, 2018.

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Understand Full stack components for developing web application.

CO2: Apply packages of NodeJS to work with Data, Files, Http Requests and Responses.

CO3: Use MongoDB data base for storing and processing huge data and connects with NodeJS application.

CO4: Design faster and effective single page applications using Express and Angular.

CO5: Create interactive user interfaces with react components

1. Create an application to setup node JS environment and display “Hello World”
2. Write a Node JS program to perform read, write and other operations on a file.
3. Write a Node JS program to read form data from query string and generate response using NodeJS
4. Create a food delivery website where users can order food from a particular restaurant listed in the website for handling http requests and responses using NodeJS.
5. Perform Count, Limit, Sort, and Skip operations on the given collections using MongoDB.
6. Develop a Job Registration form and validate it using angular JS.
7. Write a program to create a simple calculator Application using React JS.
8. Write a program to create a voting application using React JS
9. Develop a leave management system for an organization where users can apply different types of leaves such as casual leave and medical leave. They also can view the available number of days using react application.
10. Build a music store application using react components and provide routing among the web pages.
11. Create a react application for an online store which consist of registration, login, product information pages and implement routing to navigate through these pages

**Course Objectives: After completing this course, students will be able to**

1. Understand the fundamental ideas and mathematical techniques that governs cryptography and cybersecurity.
2. It aids in analyzing and implementing symmetric encryption algorithms, as well as in observing security protocols.
3. It is necessary to test and actively use public-key cryptography together with digital signatures in real-world network environments.
4. Explore Advanced Encryption Standard
5. Understand RSA Cryptosystem

**UNIT – I: Foundations of Cryptography and Security** Overview of Cybersecurity, Information Security, and Network Security – The OSI Security Architecture – Security Attacks, Services, and Mechanisms – Overview of Cryptographic Algorithms – Number Theory Essentials: Euclidean Algorithm – Modular Arithmetic and Prime Numbers – Fermat's and Euler's Theorems – Testing for Primality – The Chinese Remainder Theorem – Discrete Logarithms

**UNIT – II: Symmetric Cryptography and Block Ciphers:** Classical Encryption Techniques: Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Block Ciphers and Stream Ciphers

**UNIT – III: Data Encryption Standard:** Traditional Block Cipher Structure – The Data Encryption Standard – DES Example – Block Cipher Design Principles –

**UNIT – IV: Advanced Encryption Standard:** Finite Field Arithmetic – AES Structure – AES Transformation Functions – AES Key Expansion – An AES Example – AES Implementation – Block Cipher Operation: Multiple Encryption and Triple DES. Asymmetric Cryptography and Digital Signatures Symmetric vs. Asymmetric Cryptography – Practical Aspects of Public-Key Cryptography

**UNIT – V: RSA Cryptosystem:** Key Generation and Proof of Correctness – Encryption and Decryption: Fast Exponentiation – Speed-up Techniques for RSA – Padding, Attacks, Implementation in Software and Hardware – Digital Signatures: Principles of Digital Signatures and Security Services

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books**

1. William Stallings, "Cryptography and network security: Principles and practice", 8th Global Edition, Pearson Education, 2023.
2. Stallings, W., & Brown, L., "Computer security: Principles and practice", 2nd Edition, Prentice Hall, 2012.
3. Paar, C., & Pelzl, J., "Understanding cryptography: A textbook for students and practitioners", Springer, 2010.

**REFERENCES:**

1. Schneier, B., "Applied cryptography: Protocols, algorithms, and source code in C", 2 nd Edition, John Wiley & Sons. 1996.
2. Stallings, W., "Network security essentials: Applications and standards", 4th Edition, Prentice Hall, 2011.

**E-RESOURCES:**

1. <https://nptel.ac.in/courses/106105162>

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, principles, and techniques of cryptography and cyber security for securing information and communication systems.

CO2: Analyze cryptographic algorithms, security protocols, and cyber threats to understand system vulnerabilities and security requirements.

CO3: Evaluate cryptographic techniques, security mechanisms, and cyber defense strategies to assess their effectiveness against various security attacks.

CO4: Design secure systems by selecting appropriate cryptographic methods, security architectures, and cyber security controls for real-world applications.

CO5: Explore Digital Signatures schemes.

|                 |                                                               |                      |
|-----------------|---------------------------------------------------------------|----------------------|
| <b>Year: II</b> | <b>DISCIPLINE CENTRIC ELECTIVE PRACTICAL 3</b>                | <b>Semester: III</b> |
| <b>Code:</b>    | <b>2. CRYPTOGRAPHY AND CYBER SECURITY LAB<br/>(Practical)</b> | <b>Credits: 2</b>    |

1. Find the GCD of two integers using the Euclidean algorithm.
2. Implement modular addition, subtraction, multiplication, division,
3. Implement encryption and decryption using (i) Caesar Cipher (ii) Caesar substitution cipher (iii) Monoalphabetic Substitution Cipher
4. Encrypt and decrypt a given plaintext using a substitution key.
5. Implement the Playfair encryption and decryption technique.
6. Generate public and private keys and perform encryption and decryption using RSA.
7. Encrypt and decrypt data using the Advanced Encryption Standard.
8. Implementation of DES Encryption and Decryption algorithm
9. Demonstrate symmetric-key encryption and decryption using DES.
10. Generate and verify a digital signature using a suitable cryptographic algorithm

**Course Objectives: After completing this course, students will be able to:**

1. Develop basic knowledge on the available online biological databases
2. Create, integrate and mine of all kinds of nucleotide and protein databases
3. Analyze latest tools and technologies for biological data analysis and processing
4. Get Knowledge about Protein structures
5. Understand Cloud-based Biological Data formats

**UNIT – I:** Sequence Submission Tools- Introduction, relational database, motivation of biological database; Central dogma of life - Submission of sequences to the database, sequence formats, Interconversion of molecular sequences.

**UNIT – II:** Biological Data Integration and Mining -General data integration; Major areas in biological data integration; Biological data mining General and biological data mining; Case study of biological pattern discovery, Case study in biological data mining.

**UNIT – III:** Nucleotide and Protein Sequence Databases - European molecular biology laboratory (EMBL), NCBI GenBank DNA Data Bank of Japan (DDBJ), Genes and genetic disorders: COSMIC, Clinvar - SNP database (dbSNP), UniProt Knowledgebase - SwissProt and TrEMBL - Protein Information Resource (PIR).

**UNIT – IV:** Protein Structure Databases -Protein data bank (PDB), SCOP - Structural classification of proteins, CATH – Protein structure classification database.

**UNIT – V:** Cloud-based Biological Data Processing -Biological data processing in general, data processing in the cloud; Role of cloud computing in handling the huge biological data.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Book(s)**

1. Bioinformatics Database Systems, By Kevin Byron, Katherine G. Herbert, Jason T. L. Wang, 2017, 1st Edition, CRC Press, USA.

**Reference Books**

1. Biological Database Modeling 1st Edition, by Jake Chen, Amandeep S., Amandeep S, Sidhu, 2012, Artech House Publishers, UK.
2. Bioinformatics: Methods and Applications, by Dev Bukhsh Singh, Rajesh Kumar Pathak, 1st Edition, 2021, Oxford, UK.

**Course Outcomes:** Upon completion of this course, students will be able to:

CO1: Discuss concepts of biological data and database creations

CO2: Infer the process of biological data integration and mining

CO3: Distinguish among biomolecular sequence databases and structural databases

CO4: Identify various databases employed to determine protein functions, interactions and pathways

CO5: Correlate genomic and transcriptomic databases with microarray data

**Course Objectives: After completing this course, students will be able to:**

1. Understand the knowledge on basics of research and its types.
2. Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
3. Learn Ethics in Engineering Research.
4. Acquire the concepts of Intellectual Property Rights in engineering
5. Understand procedure for Copyrights

**UNIT – I: Introduction:** Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

**UNIT – II: Literature Review and Technical Reading:** New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

**UNIT – III: Introduction To Intellectual Property:** Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India. Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting. Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models.

**UNIT – IV: Copyrights and Related Rights:** Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a

Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).

**UNIT – V: Industrial Designs:** Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

### **Textbook**

1. Dr. Santosh M Nejekar, Dr. Harish Bendigeri "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24.

### **Reference Book**

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488

**Course Outcomes:** Upon successful completion of the course, students will be able to:

CO1: Know the meaning of engineering research.

CO2: Know the procedure of the literature Review and Technical Reading

CO3: Understand the fundamentals of the patent laws and drafting procedure

CO4: Understanding the copyright laws and subject matters of copyrights and designs

CO5: Understanding the basic principles of design rights

**Course Objectives: After completing this course, students will be able to**

1. Understand the principles of green computing.
2. Assess environmental impacts of computing technologies and need for green computing.
3. Explore sustainable IT practices and energy-efficient hardware system for sustainability growth.

**UNIT – I: Introduction to Green Computing:** Scope - Environmental Impact of Computing - Need for Sustainable Computing - Power-Aware Resource Management - Green IT - OCED Green IT Framework – Greening IT - Benefits and Challenges - Quantifying IT Energy Efficiency.

**UNIT – II: Green Hardware:** Life cycle of hardware - Reuse, Recycle and Dispose Green Design and Manufacturing of Computers- Green Software - Energy-Saving Software Techniques

**UNIT – III: Sustainable Software Development:** Attributes – metrics – Methodology - Energyaware Software Engineering - Green Algorithms

**UNIT – IV: Green Data Center:** Infrastructure for Energy Efficiency – server power management Green Data Storage: Practices for Improving the Energy Efficiency of Data Storage - Optical Interconnects for Green Computers and Data Centers.

**UNIT – V: Managing Green IT:** Strategizing Green Initiatives – Implementation - Green IT Laws, Standards and Protocols- Regulatory Environment and IT Manufacturers

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

#### **Text Books**

1. San Murugesan, Harnessing Green IT: Principles and Practices, Wiley, 2012.
2. Suyel Namasudra(Editor), Green and Sustainable Computing, 1st Edition, Volume 87, Elsevier, 2012.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Green IT: Reduce Your Information System's Environmental Impact", McGraw Hill, 2008.
4. Bhuvan Unhelkar, "Green IT Strategies and Applications: Using Environmental Intelligence", CRC Press, 2011.

#### **References:**

1. Balamurugan Balusamy, Naveen Chilamkurti, Seifedine Kadry, Green Computing in Smart Cities: Simulation and Techniques, Springer Singapore, 2020.
2. Mike Halsey, The Green IT Guide - How to Make Your IT Systems and Business Sustainable and Carbon Neutral, Apress, 2025

## E-Resources

1. Prof. Deepu Philip, Prof. Amandeep Singh | IIT Kanpur Link  
[http://onlinecourses.nptel.ac.in/noc21\\_mg85/preview](http://onlinecourses.nptel.ac.in/noc21_mg85/preview)
2. Prof. Sayak Banerjee | IIT Hyderabad Link  
["https://onlinecourses.nptel.ac.in/noc23\\_me138/preview"](https://onlinecourses.nptel.ac.in/noc23_me138/preview)

## Course Outcome: Upon completion of the course, students will be able to:

CO1: Describe the fundamental concepts, principles, and practices of green computing and sustainability in modern information technology systems. -- --

CO2: Analyze computing systems and technologies to assess their energy efficiency, environmental impact, and sustainability metrics.

CO3: Evaluate green computing strategies, sustainable IT practices, and regulatory frameworks for their effectiveness in reducing environmental impact.

CO4: Design sustainable computing solutions by selecting energy efficient architectures, technologies, and practices for environmentally responsible systems

CO5: Explore Green Data Centers

**Course Objectives:** At the end of the course the student will be able to:

1. Study about the Basic web concept.
2. Learn about fundamental HTML tags.
3. Understand the image related tags
4. Learn about CSS
5. Apply the different effects on tables

**UNIT – I: Defining web design-** Web design pyramid- The medium of the web – Types of websites- Web design themes.

**UNIT – II: Fundamentals of HTML-** working with text – organizing text in HTML- working with links and Urls -creating tables

**UNIT – III: Working with Images:** Colors and canvas, working with forms, interactive elements, working with multimedia

**UNIT – IV: Overview of CSS:** Backgrounds and color gradients in CSS- font and text styles-creating boxes and columns

**UNIT – V: List:** List styles, table layout-effects, frames and controls.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Thomas Powell, “Web Design: The Complete Reference Second Edition”, Tata McGraw Hill Education Private Limited, Fifteenth reprint 2013, ISBN: 978-0-07-058252-1.
2. Kogent Learning Solutions Inc., “HTML 5 Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP & jQuery Black Book”, Kogent Learning Solutions Inc., 2013, ISBN: 978-93-5004-095-9.

**Reference Books:**

1. Joel Sklar, “Principles of Web Design: The Web Warrior Series”, Cengage Learning

**Course Outcome:** Upon successful completion of this Course, the student will be able to

- CO1: Apply the design principles, techniques and technologies in web designing.  
CO2: Demonstrate the HTML tags used in designing a web page.  
CO3: Select and apply markup languages for processing, identifying and presenting information in web pages.  
CO4: Use critical thinking skills to design and create web sites.  
CO5: Design web pages using HTML and CSS.

**Course Objectives: After completing this course, students will be able to:**

1. Provide students with the fundamentals and essentials of Cloud Computing.
2. Equip students with a solid foundation in Cloud Computing for practical use and adoption in real-world scenarios.
3. Understand building blocks of Internet of Things and characteristics
4. Students will be able to explain the core concepts, characteristics, benefits, and challenges of cloud computing models and services.
5. Students will be exposed to the revolution of Internet in Mobile Devices, Cloud & Sensor Networks

**UNIT – I: Cloud Computing:** Cloud Computing Concepts, Principles of Parallel and Distributed Computing, Cloud Characteristics. Elasticity in Cloud, On-demand Provisioning.

**UNIT – II: Cloud Architecture:** Services and Storage Layered Cloud Architecture Design - NIST Cloud Computing Reference Architecture, Types of Cloud (Public, Private and Hybrid), Cloud services (IaaS, PaaS, SaaS). Architectural Design Challenges, Cloud Storage, Storage-as-a-Service, Cloud Storage Providers, S3, Resource Provisioning Methods in Cloud.

**UNIT - III: Cloud Enabling Technologies and Security Service Oriented Architecture:** REST and Systems of Systems, Web Services, Publish Subscribe Model, Basics Virtualization, Types of Virtualizations, Implementation Levels of Virtualization. Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtualization Support and Disaster Recovery. Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards.

**UNIT – IV: Internet of Things (IoT) and M2M IoT & Web Technology:** IoT Applications, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization. Difference between 1OT and M2M, M2M AND IoT Value Chains, ETSI M2M SCL resource structure, Security in ETSI M2M framework.

**UNIT – V: IOT Architecture & Platforms:** IOT architecture and different layers, IOT standards (RFID, NFC; IEEE 802. 15. 4: ZigBee, Z-WAVE, THREAD; Bluetooth Low Energy) and protocols. IOT sensors (Temperature, Pressure, Proximity etc.), Microcontrollers, Microprocessors, SoC, Arduino, Pi, Spark, Intel Galileo.

**UNIT – VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester  
Concerned

**Suggested readings/ references:**

1. Cloud Computing: Concepts, Technology and Architecture- Thomas Erl and Zaigham Mahmood, Pearson Publication
2. Cloud Computing: Implementation, Management, and Security- John W. Rittinghouse and James Ransome, CRC Press F.
3. Cloud Computing Black Book- Kailash Jayaswal, Dream Tech Press
4. The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are Changing the World-Michael Miller, Pearson
5. Internet of Things: A Hands-on Approach- Arshdeep Bahga and Vijay Madisetti, University Press
6. The Internet of Things- Oliver Hersent, David Boswarthick, and Omar Elloumy

**Course Outcome: Upon completion of the course, students will be able to:**

- CO1: Understand the cloud computing basics
- CO2: Analyze the Cloud architectures
- CO3: Identify Cloud Enabling Technologies
- CO4: Understand IoT basic concepts
- CO5: Explore IoT standards

**Course Objectives: After completing this course, students will be able to**

1. Understand the foundational principles of blockchain technology.
  2. Explore the architecture and consensus mechanisms of distributed ledgers.
  - 3 Design and develop smart contracts and decentralized applications.
  4. Evaluate real-world use cases and security issues in blockchain networks.
- Explore Bitcoins future direction
- 5.Explore blockchain Platforms and Applications:

**UNIT – I: Blockchain and Distributed Ledger Technologies:** Centralized vs. Decentralized systems- Blockchain fundamentals: blocks, chains, hash functions, Merkle trees Types of blockchain: Public, Private, Consortium-Consensus mechanisms: PoW, PoS, PBFT-Key challenges: scalability, privacy, interoperability.

**UNIT – II: Cryptographic Foundations and Consensus:** Cryptographic hash functions Digital signatures and public-key cryptography-Mining and proof-of-work in Bitcoin Byzantine fault tolerance and proof-of-stake mechanisms-Tokenomics and incentive structures.

**UNIT – III: Smart Contracts and Ethereum Platform:** Ethereum architecture and EVM Solidity programming language-Smart contract design and development-Gas optimization and security best practices-Deployment and interaction with contracts.

**UNIT – IV: Blockchain Platforms and Applications:** Hyperledger Fabric and enterprise blockchains-Corda and permissioned networks-Decentralized Finance (DeFi) and NFTs-Blockchain in supply chain, healthcare, identity, and voting-Interoperability solutions (Polkadot, Cosmos).

**UNIT – V: Challenges, Trends, and Research Directions:** Security and privacy in blockchain systems-Legal, regulatory, and ethical considerations-Scalability solutions: Layer-1 vs Layer-2-Blockchain and IoT Integration-Future trends: zk-SNARKs, DAGs, CBDCs.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Arvind Narayanan et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
2. Imran Bashir, Mastering Blockchain, Packt Publishing, 3rd Edition, 2020.
3. Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly Media

**References:**

1. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media

**E-resources:**

1. NPTEL – Blockchain and Its Applications (IIT Kharagpur)
2. NPTEL – Introduction to Blockchain Technology and Applications (IIT Kanpur)

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, architectures, and principles of blockchain technologies and their applications in decentralized systems

CO2: Analyze blockchain protocols, consensus mechanisms, and distributed ledger models to understand security, scalability, and performance.

CO3: Evaluate blockchain platforms, smart contract frameworks, and deployment strategies to assess their effectiveness for real-world applications.

CO4: Design blockchain-based solutions by selecting appropriate architectures, consensus protocols, and smart contract models for practical use cases.

CO5: Explore Challenges, Trends, and Research Directions of Bitcoin

**Code: SOFTWARE PROJECT MANAGEMENT  
(Theory)****Credits: 4****Course Objectives: After completing this course, students will be able to**

1. Understand and apply project management methodologies in software development, gain knowledge of risk management tactics and software effort estimation methodologies, and then successfully implement these ideas in practical situations.
2. Equip with practical skills in managing people, organizing teams, and fostering effective team dynamics within the framework of software projects.
3. Understand Project Engineering
4. Explore schedule Monitoring Tools
5. Understand test plans

**UNIT – I: Introduction to Software Project Management:** Defining of Software Development Process - Process - Tailoring the Process - Improving the process discipline - Need for implementing discipline. Software Production Process - Identify the Software Model - Software Process Models: Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Component Assembly Model - Software Life Cycle.

**UNIT – II: Software Development Team** - Three Vital Aspects of Software Project Management - The Team - Meaning of Leadership - Communicating in Harmony - Personality traits - Project Organizations. Project Planning: Top-Down and Bottom-Up Planning - Types of Activity - Project Duration: Schedule Monitoring Tools - Gantt Chart, PERT Chart, Critical Path.

**UNIT – III: Tracking Meetings** - Recovery plans - Schedule Work & Escalation Meetings. Project Engineering: Product Requirements - Understanding the Customer Problem to solve - Initial Investigation, Strategies for determining information requirements, Information gathering Tools - Product Objectives.

**UNIT – IV: Problem Solving Product Specifications** - Defining the Final Product - Data Flow Diagram, Data Dictionary, Structured English, Decision Trees, Decision Tables - Feasibility Study.

**UNIT – V: Software Testing:** Test Plan - Development Testing - Verification and Validation - General Testing Methods: White Box and Black Box Testing - Unit Testing - System Integration Testing - Validation Testing - System testing-Agile Testing.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Gregory M. Horine, “Project Management Absolute Beginner's Guide”, 5th Edition, Que Publishing, 2022.
2. Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, 6th Edition, McGraw Hill Education, 2020.

3. Robert K. Wysocki, “Effective Project Management: Traditional, Agile, Extreme”, 8th Edition, Wiley, 2023.

**References:**

1. Pankaj Jalote, “Software Project Management in Practice”, 1st Edition, Pearson Education, 2021.
2. Bennatan, E.M., “Software Project Management: A Practical Approach”, 4th Edition, McGraw Hill, 2022.

**E-Resources:**

1. <https://archive.org/details/software-project-management-hughes>
2. <https://www.smartsheet.com/critical-path-method> 51 CO PO Mapping: CO

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, processes, and methodologies involved in software project management.

CO2: Analyze software project requirements, schedules, and resource allocation strategies to ensure effective project planning and execution.

CO3: Evaluate software project management tools, risk management techniques, and quality assurance practices to assess project success and outcomes.

CO4: Design software project plans by selecting appropriate management methodologies, tools, and metrics to deliver successful software projects.

CO5: Explore software testing strategies

**Course Objectives: After completing this course, students will be able to**

1. Introduce the fundamental concepts and evolution of generative modeling in AI.
2. Study deep generative models including VAEs and GANs and their applications.
3. Explore transformer-based models for multimodal generation.
4. Provide hands-on experience in building generative AI systems using open-source tools.
5. Analyze ethical, legal, and deployment aspects of generative technologies.

**UNIT – I: Generative AI:** Overview of Generative AI – Differences between Discriminative and Generative Models – Applications in Art, Code, and Text – Overview of Deep Learning – Introduction to Latent Variable Models – Statistical Foundations – Random Sampling – Maximum Likelihood Estimation – Brief Introduction to AI Ethics.

**UNIT – II: Concept Map:** Create a visual map showing the relationship between deep learning, latent variables, and generative models. Autoencoders and Variational Methods: Autoencoders – Undercomplete vs. Overcomplete AEs – Denoising Autoencoders – Variational Autoencoders (VAE) – Latent Space Sampling – Kullback-Leibler Divergence – Reparameterization Trick – ELBO Objective – Applications: Face Generation, Image Compression.

**UNIT – III: Generative Adversarial Networks (Gans):** Architecture – Generator and Discriminator – Minimax Objective – Deep Convolutional GAN (DCGAN) – Conditional GANs – CycleGAN, StyleGAN – Challenges: Mode Collapse, Non-convergence – Evaluation Metrics: Inception Score, FID.

**UNIT – IV: FOUNDATION MODELS AND MULTIMODAL GENERATION** Sequence Modeling – Attention Mechanism – Transformer Architecture – GPT Models – Text-to-Text and Text-to-Image Generation – CLIP and DALL·E – Multimodal Datasets – Prompt Engineering – Role of RLHF in Alignment.

**UNIT – V: Text-to-Image Generation:** Generate images using DALL·E mini or Craiyon, and critique results. Ethics, Safety and Deployment: Generative AI Risks – Deepfakes and Detection – Bias and Hallucinations – Model Interpretability.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media, 2nd Edition, 2022.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 3rd Edition, 2022.

4. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, Packt Publishing, 3rd Edition, 2020.

**Reference Books:**

1. Max Tegmark, Life 3.0: Being Human in the Age of Artificial Intelligence, Penguin Books, 2017.

**E-resources:**

1. <https://huggingface.co/learn>
2. <https://www.coursera.org/learn/build-basic-generative-adversarial-networks-gans>
3. <https://openai.com/research>
4. <https://developers.google.com/machine-learning/guides/text-classification>
5. <https://nptel.ac.in/courses/106105216>

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, models, and applications of generative artificial intelligence in creating data-driven content and solutions.

CO2: Analyze generative AI models and architectures to understand data generation processes, learning behavior, and performance characteristics.

CO3: Evaluate generative AI techniques, models, and ethical considerations to assess their effectiveness and impact in real world applications.

CO4: Design generative AI solutions by selecting appropriate models, architectures, and training strategies for practical content generation tasks.

CO5: Explore Text-to-Image Generation techniques

**Course Objectives: After completing this course, students will be able to**

1. Provide a comprehensive understanding of E- business systems, covering their evolution, marketing strategies, security mechanisms, and payment solutions.
2. It emphasizes the integration of ERP, CRM, SCM, mobile commerce, and knowledge management to streamline business processes.
3. Students will also explore enabling technologies, real- time E- commerce strategies, and regulatory frameworks like the IT Act 2000.
4. Explore Mobile Commerce and Technologies
5. Understand ERP Processes

**UNIT – I: Evolution of E-Commerce:** History – Early Business Information Interchange Efforts – Emergence of internet– WWW. E- Commerce – Advantages– Disadvantages – BAM Models – Transition to E- Commerce in India– E-Transmission Challenges– The Information Technology Act 2000 – Business Models – Enabling Technologies of WWW.Social Networks– Auctions– Portals: Social networks and online communities – Online auctions – E- commerce portals.

**UNIT – II: Electronic Marketing:** Security and Payment Traditional Marketing – Web Presence Goal – Browsing Behavior Model – Online Marketing– E-Advertising– Trends– E- branding– Strategies. E- Security – Internet Security– E-business Risk Management Issues– Information Security Environment in India. E- Payment – Concerns in Internet Banking– Digital Payment Requirements– Token Based E- Payment Classification– E- Cash– Cheque Payment– Risk and E- Payment. P

**UNIT – III: CRM:** SCM & SKM E- CRM Solutions – Business Touch Points – Case Studies. Supply Chain – The new way– E- logistics– Fulfilling Customer's Needs– Smart Chains Smarter Gains. Real Time Benefits and Strategies – Advantages. Knowledge as Key Business Asset– Changes in – Global Business Economy– Technology. Knowledge – Definition– Management – Knowledge Management– Data Warehousing and Data Mining. Virtual value chain – Dimensions – E-Commerce Strategy – planning E- Commerce Project.

**UNIT – IV: Mobile Commerce and Technologies:** E- Business Portals. What? – Issues – Wireless– Cellular– Wireless Spectrum. – Success Stories. Technologies – mobile commerce– WAP Wireless Generations. Portals – Different Types– benefits– features. Requirements for Intel.

**UNIT – V: ERP & EDI** Introduction – ERP and E2RP – Business Problems– New Paradigm– Drivers – Business processes and supporting processes. Architecture– Implementation– ERP Processes. ERP – Cloud and Open Sources. EDI– Concepts and Technology.

**UNIT – VI: Current Contours** (For continuous internal assessment only):  
Contemporary Developments Related to the Course during the Semester Concerned

**Text Books:**

1. P.T. Joseph S.J, “E Commerce – An Indian Perspective”, 7th Edition, PHI Learning Private Limited, 2023
2. Kenneth C. Laudon & Carol Guercio Traver, “E Commerce: Business – Technology – Society”, 17th Edition, Pearson, 2021

**References:**

1. Sandeep Desai & Abhishek Srivastava, “ERP to E2RP – A Case Study Approach”, 1st Edition (Eastern Economy), PHI Learning Private Limited, 2013
2. Kamalesh K. Bajaj & Debjani Nag, “E Commerce – The Cutting Edge of Business”, 2nd Edition, McGraw Hill Education (India), 2005.
3. Elder Moraes, “Java EE 8 Cookbook: Build reliable applications with the most robust and mature technology for enterprise development”, 1st Edition, Packt Publishing,

**E-Resources:**

1. NPTEL Course on E-Business –  
<https://nptel.ac.in/courses/110/105/110105083>
2. NPTEL Digital Marketing –  
<https://nptel.ac.in/courses/110/105/110105150>
3. Java EE Tutorials – <https://youtube.com/@JavaBrainsChannel>
4. W3Schools Java Servlet Guide –  
[https://www.w3schools.com/java/java\\_servlets.asp](https://www.w3schools.com/java/java_servlets.asp)
5. SWAYAM Portal – <https://swayam.gov.in>

**Course Outcomes: Upon completion of the course, students will be able to:**

CO1: Describe the fundamental concepts, architectures, and technologies of e-commerce systems used for online business transactions.

CO2: Analyze e-commerce platforms and transaction models to understand system functionality, security, and performance.

CO3: Evaluate e-commerce technologies, payment systems, and security mechanisms to assess their effectiveness in real world business environments.

CO4: Design e-commerce solutions by selecting appropriate technologies, architectures, and security strategies for scalable online applications.

CO5: Explore ERP Processes

**Course Objectives: After completing this course, students will be able to:**

1. Introduce the students to the concept of Startups and Entrepreneurship.
2. Provide the knowledge of becoming an entrepreneur by identifying business opportunities and developing business plans.
3. Know about the different supports for Entrepreneurs
4. Understand enterprise planning
5. Develop business models

**UNIT – I: Introduction:** Meaning and importance of Entrepreneurship, Evolution of the term entrepreneurship, Factors influencing entrepreneurship, characteristics of entrepreneurship, types of entrepreneurship, objectives of entrepreneurship development, Startups- Definition, Types.

**UNIT – II: Entrepreneurship Development Skills:** Types of entrepreneurial skills - team work and leadership skill, analytical and problem solving skills, critical thinking skills, branding, marketing and networking skills. Role of entrepreneurship development programmes (EDP)

**UNIT – III: Institutions supporting Entrepreneurs:** Various Central and State Level Organizations which Help the Entrepreneurs, Banks and non banking financial organisations, Fund Collection for Entrepreneurship

**UNIT – IV: Entrepreneurial opportunity and enterprise planning:** Sensing entrepreneurial opportunities, selecting the right opportunity, Site Selection, Feasibility Analysis

**UNIT – V: Preparation of Business model/Plan:** Business plan - concept, format, components of business plan. Significance of Business Plan. Making of a Business plan

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Text Books**

1. Kathleen R Allen, Launching New Ventures, An Entrepreneurial Approach, Cengage Learning.
2. Anjan Raichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International.
3. S. R. Bhowmik & M. Bhowmik, Entrepreneurship, New Age International

**Reference Books:**

1. Steven Fisher, Ja-nae' Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Mc Graw Hill Education India Pvt. Ltd.
2. Byrd Megginson, Small Business Management An Entrepreneur's Guidebook, 7th ed, McGrawHill
3. A Fayolle Entrepreneurship and new value creation, Cambridge, Cambridge University Press

**Course Outcome:** Upon completion of the course, students will be able to:

CO1: Students will be able to start his/ her own business by understanding the opportunities that are lying in front of them.

CO2: He / she will learn how to make a business plan and how to approach funding agencies for getting their loans sanctioned.

CO3: Develop Entrepreneurship Development Skills

CO4: Understand Entrepreneurial opportunity

CO5: Develop business models

**Course Objectives: After completing this course, students will be able to:**

1. Understand foundations of R
2. Apply matrix and arrays operations
3. Learn statistical foundations
4. Understand regression analysis
5. Apply graphics methods

**UNIT – I: Foundations of R** - Mathematics and Data Structures Overview of R and its application, Numeric, Arithmetic, Assignment, And Vectors: R for Basic Math, Arithmetic, Logarithms and Exponentials, E-Notation, Assigning Objects, Vectors, creating a Vector, Sequences, Repetition, Sorting, and Lengths, Subsetting and Element Extraction, Vector-Oriented Behavior

**UNIT – II: Matrices and Arrays:** Defining a Matrix, subsetting, Matrix operation and Algebra, Multidimensional array, Non-Numeric Values: Logical values, character, factors, List and Data frame. Special values, classes and coercion. Basic Plotting, Reading and Writing Files: R-Ready Data Sets, reading in external data files, Writing out data files and plot.

**UNIT – III: Programming Essentials and Statistical Foundations**  
**Programming:** Calling Functions, conditions and Loops, Writing Functions, Exceptions, Timings, and Visibility. Statistics and Probability: Elementary Statistics, Basic Data Visualization, Probability, Common Probability Distributions

**UNIT – IV: Statistical Inference and Regression Analysis in R:** Sampling Distributions and Confidence, Hypothesis Testing, Analysis of Variance, Simple Linear Regression, Multiple Linear Regression, Linear Model Selection and Diagnostics.

**UNIT – V: Advance Graphics:** Advanced Plot Customization - Going Further with the Grammar of Graphics, Defining Colors and Plotting in Higher Dimensions, Interactive 3D Plots.

**UNIT – VI: Current Contours** (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

**Books:**

1. The Book of R: A First Course in Programming and Statistics, by Tilman M. Davies

**References:**

1. R in Action, Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publication.
2. THE ART OF R PROGRAMMING, by Norman Matloff, No Starch Press, ISBN-10: 1-59327-384-3

**Course Outcome: Upon completion of the course, students will be able to:**

CO1: Acquire proficiency in fundamental numeric operations, vector manipulation, matrix algebra, handling non-numeric data types, and basic plotting, enabling them to perform essential data manipulations and analyses in R.

CO2: Understand matrix operations

CO3: Apply essential R programming concepts and acquire foundational skills in elementary statistics, data visualization, and probability.

CO4: Apply R to grasp concepts related to sampling distributions, hypothesis testing, analysis of variance, and various regression techniques, enhancing their practical statistical modeling and inference skills.

CO5: Excel in advanced R plot customization, understand the nuances of the Grammar of Graphics, and gain expertise in defining colors, plotting in higher dimensions, and creating interactive 3D visualizations