Course Code:4IT209PC	**Course Title: Data Structures**	**LTPC: L-3 T-0 P-0 C-3**
Course Prerequisite: Fundamentals of programming language & logic building skills		
Course Objectives:	1. To understand fundamental data structures. 2. To perform different operations on linear and multidimensional arrays and various operations on it. 3. To study the aspects of linked lists and explore various operations performed on it. 4. To explore different operations on stack and queues along with various operations on it. 5. To analyze the fundamental concepts of tree-based data structures. 6. To study and implement the fundamental concepts of graphs and their representations.	
Course Outcomes (Expected Outcome):	On completion of the course, the students will be able to: 1. Describe fundamental data structures, their operations, algorithmic complexity, string processing techniques and pattern matching algorithms. 2. Explain linear and multidimensional arrays and various operations on it. 3. Examine different types of linked list, their memory representation and operations. 4. Analyze stack and queues data structures, their operations and applications. 5. Evaluate tree-based data structure such as binary tree, binary search trees, heaps etc. 6. Design graph and graph traversal and various sorting techniques.	
Unit I:	**Introduction to Data Structures**	**Hours: 7**
Introduction to Data structures, Data Structure Operations, Algorithmic Notation, Complexity of algorithms. String processing: storing strings, character data type, string operations, word processing, and pattern matching algorithms.		
Unit II:	**Arrays & Record Structure**	**Hours: 7**
Linear arrays: Memory Representation of arrays, traversing linear arrays, insertion & deletion operations, Bubble sort, Linear search and Binary search algorithms. Multi-dimensional arrays, Pointer arrays. Record structures.		
Unit III:	**Linked lists**	**Hours: 7**
Linked lists: Memory Representation of Linked List, traversing a linked list, searching a linked list. Memory allocation & garbage collection. Insertion & deletion operations on linked lists. Header linked lists, Two- way linked lists.		
Unit IV:	**Stacks & Queues**	**Hours: 7**
Stacks: Sequential Memory Representation of Stack, Arithmetic expressions: Polish notation. Quick sort, Recursion, Tower of Hanoi. Queues: Sequential Memory Representation of Queue, Dequeue, Priority queues.		
Unit V:	**Trees**	**Hours: 7**
Introduction to Trees, Binary trees, Memory Representation of Binary Tree, Traversing binary trees, Header nodes, Binary Search Tree, Heap and heap sort, Path length & Huffman's algorithm.		
Unit VI:	**Graphs & Sorting Algorithms**	**Hours: 7**
Introduction to Graphs, Memory representation of graphs, Warshalls' algorithm, operations on Graphs, Breadth First Search, Depth First Search. Sorting: Insertion Sort, Selection Sort, Radix sort, Merge Sort.		

Textbooks:

1. Seymour Lipschutz: Data Structures, Schaum's Outline Series, McGraw-Hill, International Editions.
2. Trembley, Sorenson: An Introduction to Data Structures with Applications, McGraw Hill.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni: Fundamentals of Data Structures, CBS Publications.
2. Data Structure Using C, Balagurusamy
3. Standish: Data Structures in Java, Pearson Education.

Course Code: 4IT210PC	**Course Title: Data Communication & Networking**	**LTPC: L-3, T-0, P-0, C-3**
Course Prerequisite:	Basic knowledge of electronics and computer fundamentals, binary systems, and an introductory understanding of networking concepts.	
Course Objectives:	1. To provide foundational knowledge of data communication and networking, including essential protocols and concepts. 2. To explain the OSI model, TCP/IP protocol suite, addressing, and communication protocols critical for network functionality. 3. To study the roles and techniques of OSI layers, including physical, data link, network, transport, and application layers. 4. To understand mechanisms like error detection, correction, flow control, and data link control for reliable communication. 5. To analyze network layer protocols (IPv4, IPv6), routing, and data transmission strategies across networks. 6. To explore transport and application layer protocols (TCP, UDP, DNS, HTTP) and their role in internet communication.	
Course Outcomes (Expected Outcome):	1. Describe the fundamental concepts of data communication, including components, types of data flow, and communication systems 2. Compare the OSI and TCP/IP models by analyzing the functionalities and protocols at each layer. 3. Apply knowledge of signal conversion methods and apply error detection and correction techniques to ensure reliable communication 4. Analyze IPv4/IPv6 protocols, and packet delivery processes 5. Compare and contrast TCP and UDP features, use cases, and transport layer mechanisms. 6. Assess application layer services like DNS and HTTP and troubleshoot networking issues using protocols and addressing schemes.	
Unit I:	**Data Communication Concepts**	**Hours: 7**
Data Communication: Components, Data Representation, Data Flow;Networks: Types of Connections, Topologies, Network Models; OSI Model; TCP\IP Protocol Suite; Addressing; Signals: Analog Signals, and Digital Signals; Transmission Media and Technologies.		
Unit II:	**Physical Layer**	**Hours:7**
Analog and Digital Data; Digital Transmission: Digital-to-Digital Conversion, Analog-to-Digital Conversion; Analog Transmission: Digital-to-Analog Conversion, Analog-to-Analog Conversion.		
Unit III:	**Data Link Layer**	**Hours:7**
Error Detection and Correction: Basic, Block Coding, Linear Block Codes, Cyclic Codes, Checksum; Data Link Control: Framing, Flow and Error Control; Protocols: Noiseless Channels, Noisy Channels, HDLC, P2P.		
Unit IV:	**Network Layer**	**Hours:7**
Logical Addressing:IPv4 Addresses, IPv6 Addresses; Address Mapping; ICMP; IGMP; Packet Delivery and Forwarding; Unicast Routing Protocols: Distance Vector, Link State; Multicast Routing		
Unit V:	**Transport Layer**	**Hours:7**
Process-to-Process Delivery; TCP/UDP Protocol Suite: UDP User Datagram with Operation and Uses, TCP Services with Features, Segment, Flow Control, and Error Control.		
Unit VI:	**Application Layer**	**Hours:7**
Upper OSI Layers: Session Layer, Presentation Layer, Application Layer functions and services, Domain Name System: Domain Name Space, Distribution, DNS in the Internet, Resolution		
Text Book: 1. "Data Communication and Networking" by Behrouz A. Forouzan, 5th Edition, McGraw-Hill Education 2. "Data and Computer Communications" by William Stallings, 10th Edition, Pearson 3. "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross, 8th Edition, Pearson		

Reference Books

1. "Computer Networks" by Andrew S. Tanenbaum and David J. Wetherall, 5th Edition, Pearson
2. "Networking Essentials" by Peter J. D. Smith, 4th Edition, McGraw-Hill Education
3. "Computer Networking: Principles, Protocols and Practice" by Olivier Bonaventure, 1st Edition, Self-published, available online (Open-source)
4. "TCP/IP Illustrated, Volume 1: The Protocols" by W. Richard Stevens, 2nd Edition, Addison-Wesley

Course Code: 4IT211PC	**Course Title: Computer Organization & Architecture**	**LTPC: L-2, T-0, P-0, C-2**
Course Prerequisite:	Computer fundamentals, analog and digital circuits	
Course Objectives:	1. To understand how Computer Systems works & its organization. 2. To give methodical treatment of machine instructions and its execution. 3. To understand organization of I/O devices and concept of Bus Arbitration. 4. To learn about the organization of main memory. 5. To introduce the concept of Cache memory and Virtual Memory. 6. To understand and analyze the design of ALU.	
Course Outcomes (Expected Outcome):	After completion of this course students will be able to- 1. Describe the basic structure of computers including functional units, addressing modes and instruction sequencing. 2. Compare the working of control unit like hardwired control and Micro-programmed control. 3. Examine the different ways of communicating with i/o devices and standard i/o interfaces. 4. Demonstrate the need of hierarchical memory system. 5. Assess Virtual Memory and Multiprocessors 6. Synthesize the basic knowledge of mathematics and logic circuits to analyze the design of ALU.	
Unit I:	**Basic structure of computer**	**Hours:05**
Hardware & software, program sequencing. concept of memory locations & address. Main memory operation. Instructions & instruction sequencing. Addressing modes.		
Unit II:	**Processing Unit**	**Hours:05**
Fundamental concepts. Execution of complete instructions. Multiple –Bus Organization. Micro-programmed control; microinstructions.		
Unit III:	**I/O organization**	**Hours:05**
Accessing I/O devices, interrupts, direct memory access, bus arbitration: Centralized and Distributed.		
Unit IV:	**Memory Unit**	**Hours:05**
Basic concepts, semiconductor RAM memories, internal organization, static & dynamic RAMs, ROMs. speed, size & cost considerations.		
Unit V:	**Cache memories**	**Hours:05**
Cache Memories, Performance considerations. Virtual memories, address translation.		
Unit VI:	**Arithmetic & Logic Unit**	**Hours:05**
Number representation. Sequential multiplication, Booths' algorithm for multiplication, integer division.		
Text Book: 1. "Computer Organization" 5th Edition by V. Carl Hamacher & S. Zaky, McGraw-Hill (ISE). 2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.		
Reference Books: 1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier. 2. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill. 3. Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education. 4. "Structured Computer Organization", 5th Edition by Tenanbaum A.S., Pearson Education.		

Course Code: 4IT212PC	Course Title: Data Structures	LTPC: L-0 T-0 P-2 C-1
Course Prerequisite: Basics of programming Language & Logic Building Skills		
Course Objectives:	1. To understand linear and nonlinear data structures, their memory representations, and real-world data representation techniques. 2. To perform operations on data structures such as insertion, deletion, searching, and traversing. 3. To learn various data searching and sorting methods along with their complexities.	
Course Outcomes (Expected Outcome):	On completion of the course, the students will be able to: 1. Apply various data structures, their operations, algorithmic complexity, string processing techniques and pattern matching algorithms. 2. Investigate linear and multidimensional arrays and various operations on it. 3. Examine different types of linked list, their memory representation and operations. 4. Analyze stack and queues data structures, their operations and applications. 5. Evaluate tree-based data structure such as binary tree, binary search trees, heaps etc. 6. Design graph and graph traversal and various sorting techniques.	

List of Experiments:

The following list is an indicative list, and the subject teacher is free to design his/her own list of experiments based on the syllabus of Data Structure (4IT201PC). Students are advised to explore the Virtual Labs Developed by Ministry of Human Resource Development Government of India available at http://www.vlab.co.in/broad-area-computer-science-and-engineering. **Minimum 10 experiments** are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi.

1. Write a program to study and implement the following operations on arrays:
    a. Create an array
    b. Insert an element into an array
    c. Delete an element from an array
    d. Search an element in an array
    e. Display the array in Forward Direction
    f. Display the array in Backward Direction
2. Write a program to traverse an array and find the sum and average of data elements from an array.
3. To study and implement various searching method:
    a. Linear search method.
    b. Binary Search method.
4. To study and execute the Pattern matching Algorithms (Slow and Fast)

5. To study and execute various sorting methods:
    a. Selection Sort
    b. Insertion Sort
    c. Merge Sort
    d. Quick Sort
    e. Heap Sort
6. To study and implement various operations on singly linked list.
    a. Traversing the linked list.
    b. Insert a node at the front of the linked list.
    c. Delete a last node of the linked list.
    d. Searching a Linked list.
7. To study and implement the following operations on the doubly linked list.
    a. Insert a node at the front of the linked list.
    b. Insert a node at the end of the linked list.
    c. Delete a last node of the linked list.
    d. Delete a node before specified position.
8. To study and implement the following operations on the circular linked list.
    a. Insert a node at the end of the linked list.
    b. Insert a node before specified position.
    c. Delete a first node of the linked list.
    d. Delete a node after specified position.
9. Understand the stack structure and execute the push, pop operation on it using array implementation.
10. Understand the Queue structure and execute the insertion, deletion operation on it using array implementation..
11. Formulate and demonstrate Transforming Infix Expressions to Postfix Expression using Stack.
12. Formulate and demonstrate the Evaluation of Postfix Expression using Stack.
13. Understand the Tree structure and implement the Pre-order, In-order, post-order traversing operations on it.
14. Understand the concept of Recursion and write a program to calculate factorial of a number using Recursion.
15. Write a Program to implement the concept of BFS algorithm.
16. Write a Program to implement the concept of DFS algorithm.
17. To study and execute Josephus problem.

Course Code: 4IT213PC	Course Title: Data Communication & Networking	L-0 T-0 P-2 C-1
Course Pre-requisite: Basic understanding of Computer Systems and Architecture, Fundamentals of Programming and Knowledge of Digital Electronics		
Course Objectives:	1. To provide a comprehensive understanding of computer networks, their architecture, and protocols. 2. To enable the practical implementation and analysis of data communication techniques like digital and analog conversion. 3. To equip students with skills to design, simulate, and analyze flow control, switching mechanisms, and network device operations	
Course Outcomes:	1. Illustrate the fundamental concepts of data communication, including components, types of data flow, and communication systems 2. Compare and contrast the OSI and TCP/IP models by analyzing the functionalities and protocols at each layer. 3. Use knowledge of signal conversion methods and apply error detection and correction techniques to ensure reliable communication 4. Analyze IPv4/IPv6 protocols, and packet delivery processes 5. Inspect TCP and UDP features, use cases, and transport layer mechanisms. 6. Synthesize application layer services like DNS and HTTP and troubleshoot networking issues using protocols and addressing schemes	

Practical based on the syllabus of Data Communication & Networking (4IT202PC)

Following list is an indicative list and the subject teacher is free to design his/her own list of experiments based on the syllabus of Data Communication & Networking Lab (4IT205PC)

1. To study computer Networks and Its topology.
2. To study and implement digital –to- digital conversion, analog-to-digital conversion, digital to analog conversion
3. To implement and check flow control in DLL
4. To study and Implement Asynchronous Protocols
5. To Study and Implement synchronous Protocols
6. To implement packet switching in network
7. To implement Circuit switching in network
8. To Demonstrate and study working of various networking devices like switch, router etc.

Students are advised to explore the Virtual Labs Developed by Ministry of Human Resource Development Government of India available at http://www.vlab.co.in/broad-area-computer-science-and-engineering

Course Code: 4IT214MD	Course Title: Introduction to Operating Systems	LTPC: L-2 T-0 P-0 C-2
Course Prerequisite:	Discrete Structures, Data Structure, Any programming Language	
Course Objectives:	1. To Understand the fundamental concepts of operating systems 2. To Explore process synchronization and deadlock management 3. To Analyze memory management techniques and virtual memory	
Course Outcomes (Expected Outcome):	On completion of the course, the students will be able to 1. Explain and apply process scheduling algorithms 2. Solve synchronization and deadlock-related issues 3. Investigate memory management techniques	
Unit I:	**Introduction to OS & Process Scheduling**	**Hours: 9**
Introduction: Operating System definition, Components and Services, Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms: Pre-emptive and Non pre-emptive FCFS, SJF, Priority, RR, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling		
Unit II:	**Process Synchronization**	**Hours: 9**
Process Synchronization Basics: The Critical-Section Problem, Semaphores, Monitors. Deadlocks: Definition & Characterization, Deadlocks Prevention, Avoidance, Detection and Recovery from Deadlock.		
Unit III:	**Memory Management**	**Hours: 9**
Memory Management Background, Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Management: Background, Demand paging scheme, Process Creation, Page Replacement Policies.		
Textbook: 1. Avi Silberschatz, P. B. Galvin, G. Gagne: “Operating System Concepts” (9/e) John-Wiley & Sons.		
Reference Books: 1. A.S. Tanenbaum “Modern Operating Systems” Pearson Education. 2. William Stallings “Operating Systems” Prentice-Hall. 3. D. M. Dhamdhere “Operating Systems” Tata McGraw-Hill. 4. P. Balkrishna Prasad: “Operating Systems” Scitech Publications (I) Pvt.		

Course Code:4IT215VS	Course Title: Computer Skills - I	LTPC: L-1, T-0, P-2, C-2
Course Prerequisite:	Basic knowledge of any Programming Language	
Course Objectives:	Throughout the course, students will be expected to demonstrate their understanding of PHP by being able to do each of the following: 1. To be able to understand basics of Web Designing. 2. To understand data and information processing techniques in Internet and WWW. 3. To Design a Web Pages using elements of HTML. 4. To be able to design web applications using CSS. 5. Basic understanding of various aspects of web technologies Java Script 6. To be able to design web applications using PHP programming.	
Course Outcomes (Expected Outcome):	On completion of the course, the students will be able to: 1. Apply the principle of Web design in Designing Website. 2. Make use of the basic elements of HTML in web design. 3. Examine the basic concept of HTML. 4. Investigate basics concept of CSS in Web Design. 5. Develop the concept of web publishing using Java Script. 6. Design HTML Form with PHP.	
Unit I:	**Introduction to Web Design**	**Hours: 05**
Introduction to Internet, WWW and Web 2.0, Web protocols and Web servers, Web Design Principles and Web site structure, Basic principles involved in developing a web site. Brief History of Internet, What is World Wide Web?, Why create a web site, Web Standards, Audience requirement.		
Unit II:	**Introduction to HTML**	**Hours: 05**
What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Markup Tags, Heading-Paragraphs, Line Breaks, HTML Tags.		
Unit III:	**Elements of HTML**	**Hours: 05**
Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.		
Unit IV:	**Introduction to Cascading Style Sheets (CSS)**	**Hours: 05**
Basics of CSS, CSS properties for manipulating texts, background, colors, Gradients, Shadow Effects, borders, margins, paddings, transformations, transitions and animations, etc., CSS box modal and CSS Flex, Positioning systems of CSS, CSS media queries.		
Unit V:	**JavaScript**	**Hours: 05**
Basics of JavaScript and Client-side scripting language, JavaScript syntaxes for variables, functions, branches and repetitions. JavaScript alert, prompt and confirm. Objects in JavaScript, Access/Manipulate web browser elements using DOM Structure, forms and validations, JavaScript events		
Unit VI:	**PHP**	**Hours: 05**
Introduction to PHP and its syntax, combining PHP and HTML, understanding PHP code blocks like Arrays, Strings, Functions, looping and branching, file handling, processing forms on server side, cookies and sessions.		

Reference Books:

1. Black Book, HTML 5, Dreamtech Press
2. Black Book, Web Technologies, Dreamtech Press.
3. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India.
4. Sebesta, Programming world wide web, Pearson Education,2007.
5. Dietel and Nieto, Internet and World Wide Web – How to program by PHI/ Pearson EducationAsia.
6. Steven Holzner, PHP: The Complete Reference TataMcGraw-Hill.
7. Steven M. Schafer, HTML, XHTML, and CSS Bible, 5ed Wiley India.
8. John Duckett, Beginning HTML, XHTML, CSS, and
9. JavaScript, Wiley India
10. Ian Pouncey and Richard York, Beginning CSS: Cascading Style Sheets for Web Design Wiley India
11. Kogent Learning, Web Technologies: HTML and Javascript, Wiley India

Minimum Ten to Twelve experiments / programming assignments must be completed based on the above syllabus covering each of the units.

Course Code: 4IT216OE1	Course Title: Intellectual Property Right	LTPC: L-2, T-0, P-0, C-2
Course Prerequisite:	Basic Knowledge of English and Report Writing	
Course Objectives:	1. Impart awareness on Intellectual Property Rights (IPR) and various regulatory issues related to IPR 2. Familiarize students with the shades of Intellectual Property Rights (IPR) 3. Awareness on intellectual property rights and various regulatory issues related to IPR.	
Course Outcomes (Expected Outcome):	After successfully completing the course, students will be able to- 1. Describe the concept of intellectual property and its role. 2. Explain the process of obtaining a patent and Industrial Design. 3. Apply the concept of copyright laws, trademark classification and criteria for registration.	
Unit I:	**Introduction to Intellectual Property Rights**	**Hours: 09**
Introduction to Intellectual Property Rights: 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. Patents, Copyrights and Related Rights, Trademarks, Trade Secrets		
Unit II:	**Patent and Industrial Design**	**Hours: 09**
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, Process of Patenting. **Industrial Design:** 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, Importance of Design Registration		
Unit III:	**Copyright and Trademarks**	**Hours: 09**
Copyrights: Classes of Copyrights, Criteria for Copyright, Ownership of Copyright, Copyrights of the Author, Copyright Infringements, Liability of Owner of an Auditorium/Hall, Fair Use Doctrine, Non-Copyright Work, Copyright Registration, Judicial Powers of the Registrar of Copyrights, Fee Structure, Copyright Symbol, Validity of Copyright. **Trademarks:** Eligibility Criteria, Who Can Apply for a Trademark, Acts and Laws, Designation of Trademark Symbols, Classification of Trademarks, Registration of a Trademark is Not Compulsory, Validity of Trademark, Types of Trademarks Registered in India		

Textbook:

1. Prof. Rupinder Tewari and Ms. Mamta Bhardwaj, "Intellectual Property: A Primer for Academia" by, Publication Bureau, Panjab University, Chandigarh, 2021.
2. K. V. Nithyananda, "Intellectual Property Rights: Protection and Management", by Cengage Learning India Private Limited, 2019.

Reference Books:

1. Deborah E. Bouchoux, "Intellectual Property for Paralegals – The Law of Trademarks, Copyrights, Patents & Trade Secrets", 4th Edition, Cengage Learning, 2012.
2. N. S. Gopalakrishnan and T. G. Agitha, "Principles of Intellectual Property", Eastern Book Company, Lucknow, 2009.
3. M. M. S. Karki, "Intellectual Property Rights: Basic Concepts", Atlantic Publishers, 2009.
4. 4. Ganguli Prabuddha, "Intellectual Property Rights--Unleashing the Knowledge Economy", Tata McGraw Hill, 2001.

Course Code: 4IT216OE2	Course Title: Artificial Intelligence	LTPC: L-2 T-0 P-0 C-2
Course Prerequisite:	Professional Communication Skill and Computer Fundamentals	
Course Objectives:	1. Introduce the fundamental concepts of Artificial Intelligence. 2. Familiarize students with problem-solving, search strategies, and AI applications. 3. Develop understanding of knowledge representation, reasoning, and machine learning basics. 4. Equip students to design simple AI-based applications.	
Course Outcomes (Expected Outcome):	1. Understand the basics and scope of Artificial Intelligence. 2. Apply search strategies for solving real-world problems. 3. Represent knowledge using logic and inference techniques.	
Unit I:	Introduction to Artificial Intelligence	Hours: 09
Definition, History, and Evolution of AI, Types of AI: Narrow, General, and Super AI, Applications of AI in real life: Robotics, Healthcare, Education, Business, Foundations and Philosophy of AI, Intelligent Agents and Environments		
Unit II:	Problem Solving and Search Strategies	Hours: 09
Problem Solving as Search, Uninformed Search: BFS, DFS, Informed Search: Best-first, A*, Heuristic functions, Game Playing: Minimax Algorithm, Alpha-Beta Pruning, Constraint Satisfaction Problems (CSP)		
Unit III:	Knowledge Representation and Introduction to Machine Learning	Hours: 09
Knowledge Representation Techniques: Propositional and Predicate Logic, Inference Mechanisms: Forward and Backward Chaining, Basics of Machine Learning: Supervised, Unsupervised, Reinforcement Learning, Simple ML Algorithms: Decision Trees, k-NN, Applications of Machine Learning and AI Ethics.		
Text Book: 1. "Artificial Intelligence – A Modern Approach", Stuart Russell and Peter Norvig Pearson Education		
Reference Books: 1. "Artificial Intelligence" Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Tata McGraw Hill 2. "Introduction to Artificial Intelligence", Wolfgang Ertel, Springer 3. "Machine Learning for Absolute Beginners", Oliver Theobald, Scatterplot Press		

Course Code:4IT216OE3	**Course Title: E-Commerce**	**LTPC: L-2 T-0 P-0 C-2**
Course Prerequisite:	Basic understanding of business concepts, internet technology, and general knowledge of commerce.	
Course Objectives:	1. Understand e-commerce basics, significance, and models (B2B, B2C, C2C, C2B). 2. Assess the advantages, challenges, and trends in e-commerce and e-business. 3. Learn e-business strategies and analyze the e-commerce landscape in India.	
Course Outcomes (Expected Outcome):	1. Gain a clear understanding of e-commerce fundamentals, its models, and their significance. 2. Analyze the advantages, challenges, and trends in e-commerce and e-business. 3. Apply e-business strategies and assess the e-commerce landscape in India.	
Unit I: Introduction to E-Commerce		**Hours: 9**
Meaning and concept of Electronic Commerce, Significance of Electronic Commerce, Scope of E-Commerce, Functions of Electronic Commerce, Electronic Commerce Application, Advantages and disadvantages of E-Commerce, Electronic Commerce V/S Traditional Commerce, Prospectus of Electronic Commerce in India		
Unit II: Electronic Commerce Revolution		**Hours: 9**
he birth of Portals, Major Modes found in E-Commerce, Matric of E-Commerce Models, E-business Models, Business-to-Customer (B2C), Business to Business (B2B), Consumer to Consumer(C2C), Consumer to Business (C2B)		
Unit III: E-Business		**Hours: 9**
Definition of Electronic Business, Evolution of Electronic Business Applications, Emerging Applications, Electronic Business Architecture, Electronic Business(e-b) initiatives, Problems of the E-Business, Electronic Business Implementation, Concept of E-Customer Relation Management, The Indian Scenario for Electronic Business		
Textbooks: 1. E-Commerce: Concepts, Models, Strategies C.S.V. Murthy, Himalaya Publishing House		
Reference Books: 1. Agrawal K.N. &Deeksha Agrawal: Business on the Net; What's & How' s of E-Commerce- Macmillan New Delhi. 2. Electronic Commerce- By Bharat Bhaskar, Tata McGraw Hill Publication, New Delhi. 3. Parag Diwan & Sunil Sharma: E-Commerce-A Manager' s Guide to E-Business; Excel Books, New Delhi. 4. Minoli and Minal: Web Commerce Technology Books Tata Mc Graw Hill, New Delhi		

Course Code:4IT217EM	Course Title: IT Ethics and Management	LTPC: L-2 T-0 P-0 C-2
Course Prerequisite:		
Course Objectives:	1. To enable the students to create an awareness of engineering and professional ethics 2. To instill moral, social values and appreciate the rights of others 3. To regulate the student's behavior in a professional environment 4. To conscious about the impact of non-ethical engineering decisions 5. To comprehend 'mind and desire control'needs for being ethical	
Course Outcomes (Expected Outcome):	On completion of the course, the students will be able to 1. Relate ethical and non-ethical situations 2. Examine the moral judgment & correlate the concepts in addressing the ethical dilemmas 3. Identify risk and safety measures in Computers, Software and Digital Information	
Unit I: Introduction to Ethics		**Hours: 9**
Senses of Engineering and professional ethics, Engineering profession & its view, Ethical issues for engineers, distinction between ethics, morals and laws, opinions vs. judgments, Ethical theories: utilitarianism, duty, right, virtue; Cost-benefit analysis in engineering, McCuen's ethical dimensions, IEEE: Code of conducts & Code of ethics		
Unit II: Professional Practices in Engineering		**Hours: 9**
Professional attributes, Difference in engineering and other professions; Ethical dilemma: right-wrong or better worse; Code of ethics for engineers in India: need and its roles; abuse of codes, ethical relativism, well-being and profession, Ethics as Design - Doing Justice to Moral Problems, Kohlberg's theory – Gilligan's theory		
Unit III: Computers, Software and Digital Information		**Hours: 9**
Emergence of Computer ethics, issues in Computer ethics: distribution of power issues, property issues, issues of privacy, professional issues, Computer crimes, Computer Software and Digital Information: Characteristics of digital information, s/w as IP, and challenges in information age, IEEE code of conduct and code of ethics		
Textbooks: 1. Prof. Susmita Mukhopadhyay, 'Ethics in Engineering Practice' IIT Kharagpur 2. Mike Martin and Roland Schinzinger, 'Ethics in Engineering', Tata McGraw Hill, New York, 2005		
Reference Books: 1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, 'Engineering Ethics – Concepts and Cases', Cengage Learning, 2009 & Thompson Learning, 2000 2. Govindarajan M., Natarajan, 'Engineering Ethics', Prentice Hall of India, New Delhi, 2004 3. Stephen Byars, 'Business Ethics', USC Marshal School of Business Kurt Stanberry, University of Houston (https://openstax.org/details/books/business-ethics)		

Note: The syllabi provided for each subject are indicative and intended solely for reference. As the courses are to be offered through online platforms such as MOOC, NPTEL, or other duly approved content providers, complete alignment of course content with the prescribed syllabus may not always be feasible. Accordingly, the syllabi are to be regarded as a notional framework.

The Head of the Department, in consultation with the duly constituted committee, shall exercise due diligence in the evaluation and approval of online courses opted by students, ensuring that the intended learning outcomes are in reasonable conformity with the reference syllabus.

Information Technology

Track: Advanced Databases (Honours / Double Minor)

SEM III	3IT245DH1	Introduction to Databases	4	Theory
SEM IV	4IT246DH1	SQL and NoSQL Databases	4	Theory

Syllabus

Subject Code : 4IT246DH1

Subject Title: SQL and NoSQL Databases

Course Pre-requisites : Programming, Data Structure, introductory Database concepts

Course Objectives : The course aims to:

1. Introduce the **principles of relational databases** and SQL for data definition, manipulation, and retrieval.
2. Familiarize students with **advanced SQL features** such as transactions, triggers, and normalization.
3. Explain the **need for NoSQL databases**, their classifications, and trade-offs between consistency, availability, and scalability.
4. Provide hands-on understanding of **data modeling, querying, and scaling** in NoSQL systems such as MongoDB, Cassandra, and Redis.
5. Develop the ability to **evaluate SQL, NoSQL, and polyglot persistence strategies** in real-world enterprise contexts.
6. Introduce **emerging database trends** including NewSQL, DBaaS, and multi-model databases.

Course Outcomes :

CO1: **Explain** the evolution of databases, relational model fundamentals, SQL basics, and ACID properties.

CO2: **Apply** SQL commands for data definition, manipulation, retrieval, and enforce constraints, joins, and views.

CO3: **Analyze** advanced SQL features such as transactions, subqueries, triggers, and normalization, and **evaluate** trade-offs in denormalization.

CO4: **Explain** the concepts of NoSQL systems, including CAP theorem, BASE properties, and different NoSQL data models (key-value, document, column family, graph).

CO5: **Design** schemas for NoSQL databases, **implement** querying, and **apply** scaling strategies (sharding, replication) using case studies like MongoDB and Cassandra.

CO6: **Evaluate** coexistence strategies of SQL and NoSQL (ETL, replication, security, backup), and **explore** emerging database technologies like NewSQL and multi-model systems.

Course Syllabus

Unit I – Introduction to Databases: Evolution of data management: file systems vs. databases, Relational model basics: tables, tuples, attributes, Overview of Structured Query Language (SQL), Transaction concepts: ACID properties, Introduction to Polyglot Persistence

Unit II – SQL Foundations: Data definition: CREATE, ALTER, DROP, Data manipulation: INSERT, UPDATE, DELETE, Retrieval: SELECT, WHERE, ORDER BY, GROUP BY, HAVING, Joins: inner, outer, cross, Views, indexes, constraints (primary, foreign, unique)

Unit III – Advanced SQL and Transactions: Subqueries, set operations, window functions (overview), Stored procedures, triggers, functions (concepts), Transactions, concurrency control, locking, Normalization (1NF–3NF) and denormalization trade-offs

Unit IV – NoSQL Fundamentals: Limitations of relational systems for scale and flexibility, CAP theorem & BASE properties, Key–value stores, document stores, column family, graph databases, Consistency vs. availability trade-offs

Unit V – Data Modeling in NoSQL Systems: Schema design for key–value & document stores, Aggregates, entity relationships in NoSQL, Patterns for scaling and sharding, Case studies: MongoDB, Cassandra, Redis (conceptual), Polyglot persistence strategy in enterprises.

Unit VI – Practical Aspects & Emerging Trends: Querying in NoSQL (MongoDB queries, Cassandra CQL overview), Performance tuning and indexing across SQL/NoSQL, Migration and coexistence strategies (ETL, replication), Security, backup, and recovery in mixed environments, Emerging trends: NewSQL, cloud DBaaS, multi-model databases

References:

1. Pramod J. Sadalage & Martin Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, Addison-Wesley, 2013.

2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan – *Database System Concepts* (7th Edition), McGraw-Hill, 2020
3. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom – *Database Systems: The Complete Book* (3rd Edition), Pearson, 2020
4. Ramez Elmasri, Shamkant B. Navathe – *Fundamentals of Database Systems* (7th Edition), Pearson, 2017
5. Jeffrey A. Hoffer, V. Ramesh, Heikki Topi – *Modern Database Management* (13th Edition), Pearson, 2021
6. Alan Beaulieu – *Learning SQL* (3rd Edition), O'Reilly, 2020
7. John L. Viescas, Michael J. Hernandez – *SQL Queries for Mere Mortals* (4th Edition), Addison-Wesley, 2018

Track: Data Science and Analytics (Honours / Double Minor)

SEM III	3IT245DH2	Data Science	4	Theory
SEM IV	4IT246DH2	Natural Language Processing	4	Theory

Syllabus

Honors Track : Data Science and Analytics

Subject Code : 4IT246DH2

Subject Title: Natural Language Processing

Course Pre-requisites : Knowledge of Python Programming , mathematics and Machine learning fundamentals

Course Objectives : The course aims to:

1. Introduce the foundations of **Natural Language Processing** and challenges in working with human language data.
2. Familiarize students with **text preprocessing, representation techniques, and embeddings** for NLP tasks.
3. Develop skills to implement **text classification, sentiment analysis, and information extraction** using ML and deep learning methods.
4. Provide exposure to **sequence modeling, text generation, machine translation, and chatbot development** using advanced models.
5. Enable learners to work with **state-of-the-art transformer architectures** (BERT, GPT, T5) and apply them to real-world NLP applications.
6. Train students to **deploy and optimize NLP models** using industry-standard frameworks and tools.

Course Outcomes :

CO1: **Explain** the fundamentals, applications, and challenges of NLP, and apply Python libraries (NLTK, spaCy, TextBlob) for preprocessing tasks such as tokenization, stemming, lemmatization, and POS tagging.

CO2: **Implement** various text representation methods (BoW, TF-IDF, embeddings) and **analyze** their effectiveness in classification and sentiment analysis using ML and deep learning approaches.

CO3: **Apply** named entity recognition, information extraction, and topic modeling techniques (LSA, LDA, NMF) for document clustering and knowledge discovery.

CO4: **Develop** text generation, machine translation, and chatbot systems using RNNs, LSTMs, seq2seq models, and transformer-based architectures (BERT, GPT).

CO5: **Experiment with** advanced pretrained language models (BERT, GPT, XLNet, T5) and **evaluate** their performance in applications such as sentiment analysis, QA systems, and fake news detection.

CO6: **Deploy** NLP models using Flask/Django and Hugging Face, and **optimize** them for real-world applications in domains like healthcare, finance, and social media.

Course Syllabus

Unit I: Introduction to NLP: Overview of NLP and its applications, Challenges in NLP, Introduction to Python for NLP, Overview of NLP libraries: NLTK, spaCy, TextBlob, genism, Text Preprocessing and Tokenization: Tokenization (Word, Sentence, Subword), Stemming and Lemmatization, Stopwords Removal, Regular Expressions (Regex) for Text Cleaning, Part-of-Speech (POS) Tagging

Unit II: Text Representation: Bag of Words (BoW) Model, Term Frequency-Inverse Document Frequency (TF-IDF), Word Embeddings: Word2Vec, GloVe, FastText, Contextual Embeddings: BERT, ELMo, Transformer-based embeddings, Text Classification and Sentiment Analysis, Rule-based text classification, Supervised learning models for NLP (Naïve Bayes, SVM, Random Forest), Sentiment Analysis using NLTK and VADER, Deep learning models for text classification (LSTMs, CNNs, Transformers)

Unit III: Named Entity Recognition (NER) and Information Extraction: Named Entity Recognition with spaCy, Rule-based vs. Machine Learning-based NER, Relationship Extraction, Topic Modeling and Document Clustering: Latent Semantic Analysis (LSA), Latent Dirichlet Allocation (LDA), Non-negative Matrix Factorization (NMF), Document Clustering using K-Means, DBSCAN, Hierarchical Clustering

Unit IV: Text Generation and Sequence Modeling: Markov Chains for Text Generation, Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTMs), Transformer-based models (GPT, BERT for text generation), Machine Translation and Chatbots: Rule-based and Statistical Machine Translation, Neural Machine Translation (NMT) with seq2seq models, Building Chatbots with Rasa or Dialogflow, Transformer-based Chatbot using GPT

Unit V: Advanced NLP with Deep Learning: Pretrained Language Models: BERT, GPT, T5, XLNet, Fine-tuning transformers for NLP tasks, Zero-shot and Few-shot Learning in NLP, NLP Applications and Case Studies, Speech Recognition with NLP, Fake News Detection, Question Answering Systems, NLP in Healthcare and Finance

Unit VI: NLP Deployment and Productionization: Building and deploying NLP models using Flask/Django, Using Hugging Face for model deployment, Model evaluation and optimization

References:

1. Natural Language Processing with Python, Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media
2. Speech and Language Processing, Daniel Jurafsky, James H. Martin, Pearson
3. Text Mining with Python: A Practical Real-World Approach, Dipanjan Sarkar, Apress
4. Python Natural Language Processing Cookbook, Krishna Bhavsar, Naresh Kumar, Pratap Dangeti, Packt Publishing

5. Deep Learning for Natural Language Processing, Palash Goyal, Sumit Pandey, Karan Jain, Apress
6. Covers: RNNs, LSTMs, Transformers, BERT, GPT, and neural text generation.
7. Building Chatbots with Python, Sumit Raj, Packt Publishing
8. Practical Natural Language Processing, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, O'Reilly Media