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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23DC1010** | **Duration** | **3hrs** |
| **Course Title** | **ETHICS IN INFORMATION TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define ethics. | | CO1 | U | 1 |
| 2. | Identify the proposer of the concept of macro engineering ethics. | | CO1 | R | 1 |
| 3. | State the primary focus of the Information Technology Act (ITA) 2000. | | CO2 | R | 1 |
| 4. | Identify one type of cyber attack that compromises system confidentiality. | | CO2 | R | 1 |
| 5. | Define the term patent troll. | | CO3 | U | 1 |
| 6. | Define copyright infringement. | | CO3 | R | 1 |
| 7. | List the five maturity levels of the CMMI model. | | CO4 | U | 1 |
| 8. | State the meaning of Quality Assurance (QA) in software development. | | CO4 | R | 1 |
| 9. | Define cyberbullying in the context of social networks. | | CO5 | U | 1 |
| 10. | State the primary purpose of an Information Security Management System (ISMS). | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the PDCA (Plan–Do–Check–Act) cycle and its application in continuous improvement. | | CO1 | An | 3 |
| 12. | Differentiate between the ITA 2000 provisions for confidentiality, integrity, and availability. | | CO2 | U | 3 |
| 13. | Compare copyright and patent protection mechanisms using relevant examples. | | CO3 | U | 3 |
| 14. | Describe the role of Quality Circles in software development organizations. | | CO4 | U | 3 |
| 15. | Analyze the ethical issues arising from outsourcing practices in IT organizations. | | CO5 | An | 3 |
| 16. | Explain the role of ISO 27001 standard in information security auditing. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Elaborate on the concept of professional ethics in engineering and discuss the ethical framework, including personal virtues, corporate policies, and professional codes. | CO1 | A | 8 |
|  | b. | Explain the four leadership styles (Transactional, Transformational, Charismatic, and Situational) with relevant examples in engineering management. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain the overview and classification of cyber-attacks along with the characteristics of viruses, worms, Trojan horses, and DDoS attacks, with real-world examples | CO2 | A | 6 |
|  | b. | Discuss the ethical issues faced by IT professionals, employers, and clients in the workplace, including whistleblowing and bribery concerns. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Analyze the different types of intellectual property: copyrights, patents, and trade secrets. Discuss patent infringement, software piracy, and plagiarism with case examples. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Discuss the Capability Maturity Model Integration (CMMI) in detail. Explain the five maturity levels and their characteristics in software development processes | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the ethical challenges in social networking including cyberbullying, cyberstalking, and online predation, propose solutions for responsible social media use. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the structure and requirements of ISO 27001 ISMS standard. Explain the 14 domains of information security and their implementation. | CO6 | An | 8 |
|  | b. | Describe the business continuity planning process including impact analysis, threat identification, and recovery strategies. | CO6 | U | 4 |
|  |  |  |  |  |  |
| 23. |  | Explain the concept of Organisational Culture and Climate, and their impact on ethical behavior. | CO1 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the information security auditing process, including the pre-audit, planning, fieldwork, analysis, reporting, and follow-up phases, with suitable practical examples. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Observe professional ethics and organizational culture and climate in information technology. |
| **CO2** | Identify the various leadership styles and the suitability for the specific organization. |
| **CO3** | Survey the possible computer crimes and the rules and regulations for protection. |
| **CO4** | Appraise various types of IPR and the procedures for obtaining IPR. |
| **CO5** | Categorize various types of social networking and ethical issues. |
| **CO6** | Articulate the standards for Information Security Management Systems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2001** | **Duration** | **3hrs** |
| **Course Title** | **OBJECT ORIENTED PROGRAMMING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define encapsulation in Java. | | CO1 | An | 1 |
| 2. | Name two features of Java | | CO1 | A | 1 |
| 3. | Define method overriding. | | CO2 | R | 1 |
| 4. | Name one use of packages. | | CO2 | R | 1 |
| 5. | Give one example of a checked exception. | | CO3 | U | 1 |
| 6. | Define multithreading. | | CO3 | R | 1 |
| 7. | What is byte stream in Java I/O? | | CO4 | A | 1 |
| 8. | Give an example for each checked and unchecked exceptions | | CO4 | R | 1 |
| 9. | Define a lambda expression. | | CO5 | U | 1 |
| 10. | Name one Swing component. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the primitive data types in Java with their sizes. | | CO1 | An | 3 |
| 12. | Explain partial implementation of interfaces. | | CO2 | U | 3 |
| 13. | Write a try-catch block to handle **Arithmetic Exception**. | | CO3 | An | 3 |
| 14. | Compare auto boxing and unboxing in Java. | | CO4 | U | 3 |
| 15. | Differentiate between Stack and Queue. | | CO5 | An | 3 |
| 16. | Describe the role of Event Handling in Java. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain data abstraction in Java and its importance in large-scale software development. | CO1 | U | 6 |
|  | b. | Discuss the advantages of object-oriented programming. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare method overloading and method overriding in detail. | CO2 | An | 6 |
|  | b. | Design a real-world scenario using inheritance, polymorphism, and interfaces. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the lifecycle of a thread with diagram and example. | CO3 | U | 6 |
|  | b. | Differentiate between checked and unchecked exceptions with examples. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Demonstrate text file manipulation using FileReader and FileWriter. | CO4 | E | 6 |
|  | b. | Write a program to count word frequency in a text file. | CO4 | C | 6 |
|  |  |  |  |  |  |
| 21. | a. | Demonstrate List, Set, and Map collections with examples. | CO5 | E | 6 |
|  | b. | Implement a generic method that works for different data types. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Write a Java program combining inheritance, interfaces, and polymorphism. | CO2 | C | 6 |
|  | b. | Explain the significance of dynamic binding in object-oriented programming. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Implement exception handling in file reading operations. | CO3 | E | 6 |
|  | b. | Design a Java application that demonstrates the significance of multithreading. | CO3 | C | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Design a GUI application using Swing controls to take user input and display it. | CO6 | C | 6 |
|  | b. | Compare AWT and Swing components with examples. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Identify core Java fundamentals and object-oriented principles. |
| **CO2** | Develop object-oriented features and interfaces to enhance software functionality and user interaction. |
| **CO3** | Analyze the mechanisms of multithreading and exception handling to optimize performance and reliability. |
| **CO4** | Evaluate file I/O and string manipulation techniques for improved data handling. |
| **CO5** | Utilize Java generics and collections for enhanced code efficiency. |
| **CO6** | Develop desktop applications using Java Swing to solve real-time problems |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2003** | **Duration** | **3hrs** |
| **Course Title** | **DATA STRUCTURES AND ALGORITHMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Abstract Data Type. | | CO1 | R | 1 |
| 2. | State the meaning of backtracking in algorithm design. | | CO1 | R | 1 |
| 3. | List any two applications of a queue. | | CO2 | R | 1 |
| 4. | Name the operation used to insert an element into a queue implemented using an array. | | CO2 | R | 1 |
| 5. | Name the properties that should be satisfied by a heap. | | CO3 | R | 1 |
| 6. | Identify the maximum number of nodes at the last level of a complete binary tree with *n* nodes. | | CO3 | R | 1 |
| 7. | Differentiate between Breadth First Search and Depth First Search. | | CO4 | U | 1 |
| 8. | Cite when does a graph become a tree | | CO4 | R | 1 |
| 9. | Predict the sorted output of the array [8, 3, 5, 1] using Selection Sort. | | CO5 | U | 1 |
| 10. | **Define** String Searching algorithms. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between linear data structure and nonlinear data structure. | | CO1 | U | 3 |
| 12. | Consider the following circular linked list:    Write the code to insert “23” at the front of the above circular linked list. | | CO2 | A | 3 |
| 13. | Compare Binary TreeandBinary Search Treebased on structure and usage. | | CO3 | U | 3 |
| 14. | **List** any three real world applications of Graph. | | CO4 | R | 3 |
| 15. | Name any three comparison based sorting algorithms. | | CO5 | R | 3 |
| 16. | Differentiate between selection by sorting and partition based selection algorithms. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explore the concept of Big O, Big Omega, and Big Theta notations with the practical examples of each. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Predict the values are returned during the following sequence of queue operations, if executed on an initially empty queue.  Enqueue(5), enqueue(3), dequeue(), enqueue(2), enqueue(8), dequeue(), dequeue(), enqueue(9), enqueue(1), dequeue(). | CO2 | U | 5 |
|  | b. | Write the pseudocode for performing the following operations on a singly linked list.   1. Delete a node at any arbitrary location b) Insert a node at the end. | CO2 | A | 7 |
|  |  |  |  |  |  |
| 19. |  | Construct an AVL Tree by inserting the following values 44, 27, 32, 78, 90, 38, 48, 80, 62, 54, and perform the different rotations used to balance the tree. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Apply the Kruskal’s algorithm to find the minimum spanning tree of a graph and present its pseudocode | CO4 | A | 7 |
|  | b. | Construct an adjacency matrix and the adjacency list for the given graphs. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 21. |  | Construct the hash table and insert the following data using hash function h(X)= X mod 9 { 17, 9, 34, 56, 11, 71, 86, 55, 22, 10, 4, 39, 49, 52, 82, 13, 40, 31, 35, 28, 44} for each of the following scenario.   1. Collisions are handled by linear probing. 2. Collisions are handled by separate chaining. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Apply an appropriate algorithm to find the shortest path from ‘A’ for the below graph. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Demonstrate the various operations that can be performed on doubly linked list along with their pseudocode. | CO2 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze and compare the working steps of linear search and binary search algorithms by searching the key 45 on the arrays 5,12,18,23,45,56,72,81 and 95 | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the concept of fundamental data structures. |
| **CO2** | Apply complex data structures for efficient data organization. |
| **CO3** | Demonstrate different types of tree data structures and the applications of heap. |
| **CO4** | Demonstrate the graph representations and traversals. |
| **CO5** | Demonstrate the working of sorting and application of hashing. |
| **CO6** | Apply various searching and selection techniques to solve problems efficiently. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2013** | **Duration** | **3hrs** |
| **Course Title** | **COMMUNICATION FOR CYBER PHYSICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q.**  **No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the protocol most suitable for achieving short-range, low-latency communication in industrial systems. | | CO1 | R | 1 |
| 2. | Identify the computing model that extends cloud capabilities to the edge of a network for faster data processing. | | CO1 | R | 1 |
| 3. | Explain the concept that enables service delivery over the Internet using a pay-as-you-go approach. | | CO2 | U | 1 |
| 4. | Identify the purpose and working principles of the MQTT and XMPP protocols used in IoT communication. | | CO2 | U | 1 |
| 5. | State the protocol designed for lightweight publish/subscribe communication among IoT-enabled devices. | | CO3 | R | 1 |
| 6. | Name the MAC protocol that performs channel sensing to prevent data collisions during transmission. | | CO4 | R | 1 |
| 7. | State the key features that define the REST architectural framework. | | CO5 | R | 1 |
| 8. | List the major benefits of implementing UDP header compression in network communication. | | CO5 | R | 1 |
| 9. | State the abbreviation for AMQP and summarize its essential features. | | CO5 | R | 1 |
| 10. | Define the concept of Data Distribution Service (DDS) and outline its main functionality. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between CoAP and HTTP protocols based on their suitability and effectiveness in IoT applications. | | CO1 | U | 3 |
| 12. | Explain the concept and importance of Fog Computing in enabling distributed processing near the data source. | | CO2 | U | 3 |
| 13. | Classify and describe the different types of data transmission methods used in communication systems. | | CO3 | U | 3 |
| 14. | Distinguish the addressing structure and features of IPv4 and IPv6 communication protocols. | | CO4 | U | 3 |
| 15. | Infer the main characteristics and advantages of the 6LoWPAN protocol in IoT networks. | | CO5 | U | 3 |
| 16. | Illustrate how the Data Distribution Service (DDS) architecture enables interoperability among communicating systems. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | A smart city authority is planning to deploy a large-scale wireless sensor network (WSN) to monitor traffic congestion, street lighting, and air pollution levels. The sensors will transmit data periodically to a central control unit. However, the system must ensure efficient channel utilization, minimal data collision, and low power consumption since most of the nodes are battery-powered and communicate wirelessly in a dense network environment. Classify the types of MAC protocols. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Differentiate between Fog Computing and Edge Computing with respect to functionality and scope. | CO2 | U | 8 |
|  | b. | Identify and explain various network topologies. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. |  | Interpret the key components of the Internet of Things and describe its fundamental characteristics. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the components of the following IoT Embedded System. A smart healthcare organization is developing an IoT-based patient monitoring system to track vital parameters such as heart rate, blood pressure, and body temperature in real time. The objective is to enable early detection of health anomalies and provide timely medical assistance. The system integrates wearable sensors, embedded controllers, wireless communication modules, and cloud-based analytics platforms to continuously collect, process, and transmit data to healthcare professionals via a mobile and web interface. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | A smart home automation company is developing an IoT-based control system that allows users to manage lighting, security cameras, and household appliances remotely through a mobile app. The system must support real-time communication between devices, ensure reliable data exchange, and handle various interaction types such as device-to-device, device-to-cloud, and cloud-to-device communication. Explain the communication models and its classification. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the choice of ZigBee over Wi-Fi for the following application, citing at least two reasons from its characteristics. A smart factory requires a wireless network to connect hundreds of low- power sensors monitoring machine’s health. The sensors need to form a resilient, self-healing network and transmit small data packets infrequently. | CO5 | An | 6 |
|  | b. | Explain the types of transducers. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | A logistics company wants to improve its fleet operations by implementing a cloud-based fleet management system. The system must track delivery vehicles in real time, including their location, status, and delivery schedules. Multiple clients—mobile apps, web dashboards, and third-party services—need to access and update this data. The development team decides to design the system following REST (Representational State Transfer) architecture. Explain how adopting REST principles would impact the communication between the client applications and the central fleet management server. Explain how adopting REST principles would impact the communication between the client applications and the central fleet management server. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | "Urban Flow," an autonomous vehicle (AV) company, is deploying a fleet of self-driving taxis in a dense urban environment. A critical challenge has emerged at a large, signal-free intersection where vehicles from multiple directions must negotiate right-of-way efficiently and safely. A recent near-miss incident occurred when two AVs, approaching the intersection perpendicularly, had a conflicting trajectory. Their individual LiDAR and camera systems detected each other too late for a comfortable maneuver, as a double-parked truck created a significant occlusion. Urban Flow has decided to implement a real-time Vehicle-to-Vehicle (V2V) communication system using DDS middleware to solve this "occlusion problem" and enable cooperative driving. Illustrate the DDS system to solve occlusion problem. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Analyze the foundational concepts of IoT including terms, characteristics, enabling technologies, sensors, edge devices, and communication models. |
| CO2 | Demonstrate the components of IoT architecture: physical devices, connectivity, communication protocols, edge computing, data management, and application collaboration processes. |
| CO3 | Apply transducers, sensors, and actuators knowledge by defining, classifying, and interfacing them with embedded systems and wireless sensor networks. |
| CO4 | Analyze Layer 1/2 connectivity technologies including RFID, NFC, Bluetooth, ZigBee, LoRa, Wi-Fi, WiMAX, LTE, and their case studies. |
| CO5 | Design Layer 3 connectivity solutions by understanding IPv4 vs IPv6 addressing, IPv6 protocol, tunneling, IPsec, QoS, and 6LoWPAN. |
| CO6 | Apply communication protocols to solve real time use-cases. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2014** | **Duration** | **3hrs** |
| **Course Title** | **OPERATING SYSTEMS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain Non-volatile memory. | | CO1 | U | 1 |
| 2. | Define Operating system. | | CO1 | R | 1 |
| 3. | Sketch the different states of a process. | | CO2 | A | 1 |
| 4. | Name any two CPU scheduling algorithms. | | CO2 | R | 1 |
| 5. | Identify one classic synchronization problem. | | CO3 | U | 1 |
| 6. | Define semaphore. | | CO3 | R | 1 |
| 7. | Identify any two deadlock avoiding mechanisms. | | CO4 | U | 1 |
| 8. | Define thrashing. | | CO4 | R | 1 |
| 9. | Sketch the structure of file-control block. | | CO5 | A | 1 |
| 10. | Explain platters in a disk structure. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain Process Control Block. | | CO1 | R | 3 |
| 12. | Differentiate between Preemptive scheduling from Non-Preemptive scheduling. | | CO2 | U | 3 |
| 13. | Analyze whether the graph has deadlock or not. | | CO3 | An | 3 |
| 14. | Calculate the allocation of free page frames by using equal allocation and proportional allocation for the given condition.  **Given**:  No. of Frames: 64.  The virtual memory size is v(1)=16, v(2)=128, v(3)=64, v(4)=48. | | CO4 | A | 3 |
| 15. | Differentiate between the linked file allocation technique from indexed file allocation techniques. | | CO5 | An | 3 |
| 16. | Explain the structure of hard disk drive with its components. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the Storage Device Hierarchy of Operating System. | CO1 | U | 8 |
|  | b. | Explain the following functions of the operating system.   * Main memory management * Secondary storage management | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. |  | Calculate the Average Waiting Time and Average Turnaround Time for each of the given process using the FCFS, Non-preemptive SJF, Priority, Round Robin scheduling algorithms and provide the Gantt charts for the same.  **Given:**  Time quantum =10 milliseconds(ms). Highest Priority= 1   |  |  |  | | --- | --- | --- | | Process | CPU Burst Time (ms) | Priority | | P1 | 8 | 2 | | P2 | 15 | 4 | | P3 | 6 | 1 | | P4 | 10 | 3 | | P5 | 4 | 5 | | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Determine whether the system is in a safe state using the Safety Algorithm. If so, find the safe sequence for the given scenario.  **Scenario**:  A system has five processes (P1, P2, P3, P4, P5) and four resource types (A, B, C, D) with the following total available instances: A = 10, B = 5, C = 7, D = 8. The current allocation and maximum need of resources for each process are as follows:   | Process | Allocation (A, B, C, D) | Max (A, B, C, D) | | --- | --- | --- | | P1 | (1, 1, 2, 1) | (3, 2, 2, 2) | | P2 | (2, 0, 0, 1) | (2, 2, 2, 2) | | P3 | (3, 0, 2, 2) | (9, 0, 2, 2) | | P4 | (2, 1, 1, 0) | (4, 3, 3, 1) | | P5 | (0, 0, 2, 1) | (3, 3, 2, 2) | | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Calculate the page faults using FIFO, LRU and Optimal page replacement algorithm with 3 frames for the reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0 and check whether this string suffers from Belady’s anomaly in FIFO using 4 frames. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the different file access methods with a neat sketch. | CO5 | U | 6 |
|  | b. | Explain the concept of Fragmentation with an example for each and its types in an operating system. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain the Interrupt-Driven I/O cycle in a real time operating system with a neat diagram. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the Inter-Process Communication (IPC) mechanisms with its benefits. | CO2 | U | 6 |
|  | b. | Determine the memory allocation for each process and figure out the remaining free partitions after allocation using First Fit, Best Fit, and Worst Fit memory allocation strategies for the given condition.  **Given**:  A system has the following free memory partitions (in KB). Partition sizes are 100 KB, 500 KB, 200 KB, 300 KB, and 600 KB and the three processes need to be allocated memory in which:   * Process P1 requires 212 KB. * Process P2 requires 417 KB. * Process P3 requires 112 KB. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Calculate the Average Seek length for the below given scenario using FIFO, SSTF, SCAN and C-SCAN algorithm.  Scenario:  Consider a disk with 1000 tracks and the queue has random requests from different processes in the order:500, 345, 1780, 890, 620, 1340. Initially the arm is at 1000. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the applications of operating systems to share resources and to make programming easier for user space applications. |
| **CO2** | Distinguish user and kernel level operating. |
| **CO3** | Analyze the thread context management, synchronization methods and various  scheduling algorithms |
| **CO4** | Apply various memory management schemes especially paging and segmentation in  real time applications. |
| **CO5** | Illustrate the file systems in operating systems like UNIX/Linux and Windows. |
| **CO6** | Demonstrate the input output management, use of device driver and secondary storage. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2020** | **Duration** | **3hrs** |
| **Course Title** | **DATA SCIENCE ECOSYSTEM** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Compute the median for the dataset:[4,8,15,16,23,24]. | | CO1 | U | 1 |
| 2. | Name any two python packages commonly used for data analytics. | | CO1 | R | 1 |
| 3. | State the syntax to insert a document into collection ‘students’. | | CO2 | R | 1 |
| 4. | Identify the MongoDB query to update the age of the student named 'Alice' to 26 in the students collection. | | CO2 | R | 1 |
| 5. | Differentiate between the dimensions and measures. | | CO3 | U | 1 |
| 6. | Write Python code to create a pandas DataFrame from the dictionary {'Name': ['Alice', 'Bob'], 'Age': [25, 30]}. | | CO3 | U | 1 |
| 7. | Name the package used to import linear regression. | | CO4 | R | 1 |
| 8. | Identify any one data visualization tool used in data science. | | CO4 | R | 1 |
| 9. | State the purpose of lemmatization. | | CO5 | R | 1 |
| 10. | Identify the tokens in the sentence “Data Science is fun”. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | The average score of students in a statistics exam is 70 with a standard deviation of 8. A student scored 86 marks. Calculate the Z-score for this student and interpret the result indicates about the student’s performance compared to the class average. | | CO1 | An | 3 |
| 12. | A MongoDB collection named ‘students’ contains the following documents:  { "\_id": 1, "name": "Asha", "course": "Data Science", "marks": 85 }  { "\_id": 2, "name": "Raj", "course": "AI", "marks": 78 }  { "\_id": 3, "name": "Meena", "course": "Data Science", "marks": 92 }  Apply MongoDB CRUD operations to perform the insert operation for the student named Kiran enrolled in Cyber Security with 88 marks. | | CO2 | A | 3 |
| 13. | A data analyst is studying customer preferences for a streaming platform. The dataset contains the number of users who prefer different genres of movies:   |  |  | | --- | --- | | **Genre** | **Users** | | Action | 50 | | Comedy | 30 | | Drama | 20 |   Calculate the entropy of the user preferences for movie genres to understand the level of uncertainty or disorder in the dataset. | | CO3 | An | 3 |
| 14. | Explain the stages of the Data Analytics Life Cycle and how each stage supports the development of effective machine learning models, using suitable examples. | | CO4 | U | 3 |
| 15. | Apply the steps of text preprocessing including cleaning, tokenization, stemming, and lemmatization to a given sample sentence of your choice, | | CO5 | A | 3 |
| 16. | Explain the role of Machine Learning in building recommender systems and predictive models for domains like healthcare and crime analysis | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Using the dataset provided below, calculate the entropy and information gain for the attributes Study Hours, Attendance, and Sleep Hours. Based on your calculations, determine which attribute should be chosen as the root node for constructing a decision tree to predict whether a student passes the exam.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Student** | **Study Hours** | **Attendance** | **Sleep Hours** | **Result** | | S1 | High | High | 7 | Pass | | S2 | High | Medium | 6 | Pass | | S3 | Medium | High | 8 | Pass | | S4 | Low | Low | 9 | Fail | | S5 | Medium | Low | 5 | Fail | | S6 | High | High | 7 | Pass | | S7 | Low | Low | 6 | Fail | | S8 | Low | Medium | 8 | Fail | | S9 | Medium | High | 7 | Pass | | S10 | High | High | 8 | Pass | | S11 | Medium | Medium | 6 | Pass | | S12 | Low | Low | 5 | Fail | | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | “NoSQL databases are preferred in modern data science applications”  Explain the reason for the statement and the key differences between NoSQL and SQL in terms of scalability and flexibility. | CO2 | A | 6 |
|  | b. | Apply MongoDB commands to perform the following operations in a document database for a Data Science project:  i)Create a database named ResearchLab.  ii) Insert a new document into the collection experiments with fields (exp\_id, researcher, accuracy, model).  iii) Update the accuracy of an experiment with exp\_id = 101 to 96.7%.  iv) Delete the document where model = "Decision Tree".  v) Display all documents where accuracy > 90%. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | You are a data analyst at a fitness center. The center has collected member activity data over the past 2 years, including columns: Member\_ID, Date, Activity\_Type (e.g., Yoga, Cardio, Weight Training), Duration\_Minutes, Calories\_Burned, and Membership\_Type (Standard, Premium). The management wants to analyze member engagement patterns, activity preferences, and overall performance trends.  Analyze the fitness center’s member activity data using Python libraries to calculate average duration and calories burned per activity type per month, identify trends in member engagement and activity preferences, summarize descriptive statistics across membership types, and handle missing or inconsistent data to ensure accurate analysis. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | The table below presents data showing the relationship between Advertising Spend (in ₹ thousands) and Product Sales (in units) for a company:   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Advertising Spend (x)** | 10 | 15 | 20 | 25 | 30 | 35 | | **Product Sales (y)** | 25 | 32 | 34 | 42 | 46 | 52 |   Using the dataset provided, apply the simple linear regression model of the form  to:   1. Estimate the regression coefficients (intercept) and (slope). 2. Interpret the results and analyze the relationship between *Advertising Spend* and *Product Sales* based on your findings. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Using appropriate text mining techniques, apply the following steps to perform text analysis and information extraction on the given dataset:   |  |  | | --- | --- | | **Document ID** | **Text Data** | | D1 | "The new smartphone has an excellent camera and long battery life." | | D2 | "Battery performance is poor but the display quality is good." | | D3 | "The camera produces sharp images, and the phone design is sleek." | | D4 | "Overall, this smartphone offers great value for money." |   i) Clean and parse the text to remove punctuation, numbers, and stop words.  ii) Implement Part-of-Speech (POS) tagging to identify nouns, verbs, and adjectives.  iii) Perform stemming and lemmatization to normalize the words.  iv) Generate a frequency distribution to display the most common words in the dataset.  v) Interpret the processed results and analyze how such text analytics techniques can support data-driven decision-making in real-world applications (e.g., sentiment analysis or product improvement). | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | The following confusion matrix summarizes the performance of a Machine Learning classification model:   |  |  |  | | --- | --- | --- | |  | **Predicted: Positive** | **Predicted: Negative** | | **Actual: Positive** | 50 | 10 | | **Actual: Negative** | 5 | 35 |   Using the data provided, analyze the classifier’s performance by computing the following evaluation metrics and determine the model is balanced or biased towards any class and justify your reason.   * Accuracy * Precision * Recall (Sensitivity) * Specificity * F1-score | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | The table below shows a dataset containing information about weather conditions and whether a person plays tennis:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Day** | **Outlook** | **Temperature** | **Humidity** | **Windy** | **Play Tennis** | | 1 | Sunny | Hot | High | False | No | | 2 | Sunny | Hot | High | True | No | | 3 | Overcast | Hot | High | False | Yes | | 4 | Rain | Mild | High | False | Yes | | 5 | Rain | Cool | Normal | False | Yes | | 6 | Rain | Cool | Normal | True | No | | 7 | Overcast | Cool | Normal | True | Yes | | 8 | Sunny | Mild | High | False | No | | 9 | Sunny | Cool | Normal | False | Yes | | 10 | Rain | Mild | Normal | False | Yes | | 11 | Sunny | Mild | Normal | True | Yes | | 12 | Overcast | Mild | High | True | Yes | | 13 | Overcast | Hot | Normal | False | Yes | | 14 | Rain | Mild | High | True | No |   Using the Naïve Bayes classification algorithm,   1. Compute the required conditional probabilities and class priors based on the dataset. 2. Classify whether a person will *play tennis* under the following weather conditions:    * Outlook = Sunny    * Temperature = Cool    * Humidity = High    * Windy = True 3. Show all calculation steps, and analyze which class (Yes/No) has the higher posterior probability. 4. Interpret the results and comment on the model’s decision. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the challenges and opportunities faced by recommender systems in the era of Big Data and Artificial Intelligence. | CO6 | U | 8 |
|  | b. | Explain the way the Machine Learning models can be applied to predict the crime rate against woman. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Explain the data science principles and inference techniques |
| **CO2** | Analyze the unstructured data for insights and decision,making |
| **CO3** | Implement various python libraries for data visualization, and dashboard design principles |
| **CO4** | Demonstrate data science methods for real,world applications |
| **CO5** | Implement the text mining and NLP techniques |
| **CO6** | Apply cutting,edge technologies for impactful decision,making in diverse domains |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23DC2022** | **Duration** | **3hrs** |
| **Course Title** | **EXPLAINABLE AI** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is Explainable AI? | | CO1 | U | 1 |
| 2. | Write a short note on interpretable model. | | CO1 | R | 1 |
| 3. | What is SHAP? | | CO2 | R | 1 |
| 4. | What role does the Partial Dependence Plot (PDP) play in model interpretation? | | CO2 | R | 1 |
| 5. | How can LIME be used? | | CO3 | U | 1 |
| 6. | What is CAM in XAI? | | CO3 | R | 1 |
| 7. | List some techniques for Explainability in Text Data. | | CO4 | U | 1 |
| 8. | What is the purpose of Alternate Input Attribution? | | CO4 | R | 1 |
| 9. | What is Multimodal Data in XAI? | | CO5 | U | 1 |
| 10. | Who Uses Explainability in XAI? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Who are Explainability consumers? Give a brief on the consumers. | | CO1 | An | 3 |
| 12. | Give a brief note on shapely values with example. | | CO2 | U | 3 |
| 13. | Write the Pros and cons of Integrated Gradient. | | CO3 | An | 3 |
| 14. | What is tokenization and word embeddings in XAI? Give a comparison table. | | CO4 | U | 3 |
| 15. | Why XAI for Time-Series Data is Challenging? | | CO5 | An | 3 |
| 16. | Explain how to Effectively Present Explanations in XAI. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | What Are Explanations? Describe the different types of explanations in XAI. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Differentiate between interpretability and expandability. What are the differences between the black box model and the white box model? | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Discuss the working of LIME with a suitable example. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe about Language Interpretability Tool (LIT) handles text data. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss a complete comparative study on Influence function-based explanations and Concept-based explanations. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Compare Theoretical Approach and Empirical Approaches in XAI. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Elaborate on Benefits of XAI for Consumers. Also, explain what are the challenges of XAI? | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the interpretation of the Decision tree model with a suitable example. | CO6 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify the need and challenges in explainability and its applications |
| **CO2** | Illustrate the feature importance of explainability for tabular data |
| **CO3** | Apply explainability for image data with integrated gradients |
| **CO4** | Analyze the building models for text data explanation |
| **CO5** | Choose the alternative techniques for explainability and to evaluate explainability |
| **CO6** | Develop interaction with explainable AI users and to analyze the pitfalls in explainability |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2032** | **Duration** | **3hrs** |
| **Course Title** | **FULL STACK DEVELOPMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the HTML element used to display an image on a page. | | CO1 | R | 1 |
| 2. | Identify the CSS property used to set the width of an element’s border. | | CO1 | U | 1 |
| 3. | Identify the JavaScript event that triggers when the mouse leaves an element. | | CO2 | U | 1 |
| 4. | Define the jQuery method used to animate CSS properties over time. | | CO2 | R | 1 |
| 5. | Define the purpose of the $scope object in AngularJS. | | CO3 | R | 1 |
| 6. | Identify the AngularJS directive used to repeat items in a list. | | CO3 | U | 1 |
| 7. | List any two common events used on form elements in React. | | CO4 | R | 1 |
| 8. | State the function of the URL module in Node.js. | | CO5 | R | 1 |
| 9. | State the function of the HTTP module in NodeJS. | | CO5 | R | 1 |
| 10. | Define the purpose of the Mongoose module in Node.js applications. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the HTML code with the necessary Bootstrap class to display a danger button. | | CO1 | A | 3 |
| 12. | Write a JavaScript function that returns the square of a number. | | CO2 | A | 3 |
| 13. | Write the HTML code using AngularJS to bind an input to a variable and display it. | | CO3 | A | 3 |
| 14. | Write the basic syntax of a React functional component that shows “Hello”. | | CO4 | A | 3 |
| 15. | State the command used to run a JavaScript file in Node.js. | | CO5 | R | 3 |
| 16. | Write a simple MongoDB query to find documents where price equals 100. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Write the HTML code to create a Weekly Meal Planner table as shown, displaying days of the week along with breakfast, lunch, and dinner menus using proper borders and headings. | CO1 | A | 6 |
|  | b. | Describe the various HTML list elements with an example program. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Develop a Temperature Converter using HTML and JavaScript. The result should update whenever the user enters a temperature or selects a conversion type from the dropdown list. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Write an HTML program using JavaScript to compute and display the Total Ice-Cream Price for a selected flavour and quantity, following the given design. Show four flavours (Vanilla, Chocolate, Strawberry, Mint) with images and prices, provide a dropdown to choose a flavour and a numeric quantity field, and on clicking “Calculate Price” display Total Ice-Cream Price: Rs. \_\_\_. If the quantity is invalid, show an alert. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Develop a React application that renders a Feedback Form with fields for Full Name, Email, and Feedback, along with a Submit button. The form should handle input changes and submit events using functional components and React Hooks (useState). When the form is submitted, the entered data should be displayed in the console. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Develop a Node JS server application program to design the following HTML form to demonstrate payment transaction and display the same using Node JS HTTP module when the form is submitted via POST method.  URL: http://localhost:2000/    When Register button is clicked, the URL changed to: <http://localhost:2000/server> and display the submitted details  **The Transaction Details are:**  Car Number: 408392323923  Amount: 10000  Account Number: 1000230234323 | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Develop a HTML web page using CSS styling as per the following design. | CO1 | A | 8 |
|  | b. | Explain four CSS Selectors with suitable examples. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 23. |  | Develop the following Travel Expense Planner using client-side jQuery as given below. Here, the Stay, Food, Transport, and Fun fields accept values in percentage (%). The program should divide the entered total trip budget based on these percentage values and display each calculated expense in its respective box when the “Calculate Expenses” button is clicked. If the total percentage does not equal 100%, display an alert message indicating an invalid division. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the following MongoDB operations to manage employee information such as empid, name, department, email, phone, salary.  i) Create database company  ii) Create collection employee  iii) Insert the above employee information for 5 employees  iv) Search a particular employee using empid  v) Change the salary of a particular employee  vi) Delete the particular employee record  vii) Display all employee details whose salary is greater than 60000 | CO6 | An | 12 |
|  |  |  |  |  |  |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Design responsive web pages using front-end UI tools like HTML5, CSS3 and Bootstrap4. |
| CO2 | Create dynamic web pages using JavaScript and jQuery. |
| CO3 | Construct simple web applications using AngularJS framework. |
| CO4 | Develop simple web applications using ReactJS framework. |
| CO5 | Analyze different web applications using node.js framework. |
| CO6 | Invent the real time web applications with backend tools. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2036** | **Duration** | **3hrs** |
| **Course Title** | **AUGMENTED REALITY AND VIRTUAL REALITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give an example for the application of Virtual Reality. | | CO1 | U | 1 |
| 2. | List any two key components of an AR system. | | CO1 | R | 1 |
| 3. | Predict the motion trackers used in VR. | | CO2 | U | 1 |
| 4. | Differentiate between the VR and AR. | | CO2 | U | 1 |
| 5. | Identify the applications of extended VR techniques in healthcare. | | CO3 | U | 1 |
| 6. | State any one 3D rendering API in real world. | | CO3 | R | 1 |
| 7. | Define homogeneous transformation matrix. | | CO4 | U | 1 |
| 8. | Identify any one application of collision detection in physical modelling. | | CO4 | R | 1 |
| 9. | Show one real-world use case of AR in education. | | CO5 | U | 1 |
| 10. | Define “Immersion” in the context of Virtual Reality. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the five classic components of a VR system with examples. | | CO1 | A | 3 |
| 12. | Illustrate the working principle of motion and position trackers. | | CO2 | U | 3 |
| 13. | Explain the architecture of a 3D rendering pipeline in VR. | | CO3 | A | 3 |
| 14. | Explain the role of physical modeling in camera tracking. | | CO4 | U | 3 |
| 15. | Analyze the applications of Unity 3D in VR development. | | CO5 | An | 3 |
| 16. | Describe the use of AR in interactive museum experiences. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the similarities and differences between Virtual Reality and Augmented Reality. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the concept of human perception and cognition in immersive environments. | CO2 | An | 6 |
|  | b. | Explain the navigation and manipulation interfaces in VR systems. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Illustrate an inside-out camera tracking mechanism with a neat diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the process of physical modelling, collision detection, and force computation. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Determine the role of Unity 3D in creating VR worlds and applications. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the architecture and optimization techniques for distributed virtual reality environments. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Interpret the AR and VR applications in healthcare and manufacturing industries. | CO4 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate recent trends and challenges in AR/VR development for real-time applications. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL M – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the augmented reality and virtual reality technologies |
| **CO2** | Demonstrate motion trackers, and navigators in augmented and virtual reality environments |
| **CO3** | Estimate the effect of virtual reality and augmented reality simulation on users |
| **CO4** | Analyze camera tracking and 3D rendering in augmented reality |
| **CO5** | Implement various modelling techniques in virtual reality |
| **CO6** | Design real-time applications using virtual and augmented reality |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2038** | **Duration** | **3hrs** |
| **Course Title** | **NATURE INSPIRED OPTIMIZATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State metaheuristics and its primary objective. | | CO1 | U | 1 |
| 2. | Differentiate between exploration and exploitation in optimization | | CO1 | R | 1 |
| 3. | State the purpose of mutation operation in Genetic Algorithms. | | CO2 | R | 1 |
| 4. | Define chromosome encoding in evolutionary algorithms. | | CO2 | R | 1 |
| 5. | Compare (μ+λ) and (μ,λ) selection strategies in Evolution Strategies | | CO3 | U | 1 |
| 6. | State the key feature of CMA-ES algorithm. | | CO3 | R | 1 |
| 7. | Define the cognitive component in Particle Swarm Optimization. | | CO4 | U | 1 |
| 8. | Define gbest and lbest topologies in PSO. | | CO4 | R | 1 |
| 9. | Identify the role of luciferin in Glowworm Swarm Optimization. | | CO5 | U | 1 |
| 10. | Define dynamic optimization problem. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between heuristics, metaheuristics, and hyper-heuristics with suitable examples. | | CO1 | U | 3 |
| 12. | Explain the basic structure and working principle of Genetic Algorithm with a simple flowchart. | | CO2 | U | 3 |
| 13. | Describe the concept of Differential Evolution and its mutation strategies. | | CO3 | An | 3 |
| 14. | State the velocity and position update equations in Particle Swarm Optimization. | | CO4 | U | 3 |
| 15. | Describe the Firefly Algorithm and its biological inspiration. | | CO5 | U | 3 |
| 16. | Explain memory scheme and random immigrants scheme for dynamic optimization problems. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain Simulated Annealing algorithm in detail, covering the Metropolis criterion, cooling schedule, acceptance probability, and termination conditions with pseudocode. | CO1 | An | 8 |
|  | b. | Discuss the No Free Lunch theorem and its implications for optimization algorithm selection. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Describe Genetic Algorithm including its representation, fitness evaluation, selection, crossover and mutation operations with examples. | CO2 | U | 6 |
|  | b. | Explain the schema theorem and its significance in analyzing GA convergence. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain CMA-ES (Covariance Matrix Adaptation Evolution Strategy) algorithm in detail, covering the update rules for mean vector, covariance matrix, and step size control. | CO3 | An | 8 |
|  | b. | Compare Genetic Algorithms and Evolutionary Strategies by highlighting their key differences. | CO3 | An | 4 |
|  |  |  |  |  |  |
| 20. | a. | Explain Particle Swarm Optimization algorithm comprehensively including inertia weight, cognitive and social components, convergence analysis, and parameter tuning strategies with pseudocode. | CO4 | An | 8 |
|  | b. | Discuss various neighborhood topologies in PSO (gbest, lbest, Von Neumann, FIPS) and their impact on algorithm performance. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe Glowworm Swarm Optimization algorithm with its Algorithmic phases with pseudocode. | CO5 | A | 6 |
|  | b. | Explain the Cuckoo Search algorithm including Levy flight mechanism and nest abandonment strategy. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Discuss multimodal optimization problems and their crowding techniques | CO6 | An | 6 |
|  | b. | Describe fitness sharing mechanisms and the clearing method for maintaining diversity in multimodal landscapes. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23 |  | Describe the Artificial Bee Colony algorithm with its phases and pseudocode. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe performance metrics for multimodal optimization: ENPM (Effective Number of Peaks Maintained), MPR (Maximum Peak Ratio), and CSL (Chi-square-like) criterion with mathematical formulations. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the foundational concepts of computation inspired by nature, including biological processes, evolution, and learning. |
| **CO2** | Evaluate the principles and terminologies of evolutionary computation, including encoding/decoding, selection/reproduction, crossover, and mutation. |
| **CO3** | Apply evolutionary strategies, including CMA-ES and differential evolution, for optimization tasks. |
| **CO4** | Analyze particle swarm optimization (PSO) and ant colony optimization (ACO) for continuous and discrete optimization problems. |
| **CO5** | Distinguish various swarm intelligence algorithms, such as glowworm-based optimization and cuckoo search, for optimization tasks. |
| **CO6** | Demonstrate the dynamic, multimodal, and constrained optimization problems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23DC2040** | **Duration** | **3hrs** |
| **Course Title** | **DEEP LEARNING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name one nonlinear activation function. | | CO1 | R | 1 |
| 2. | Define convergence in learning. | | CO1 | R | 1 |
| 3. | List any two hyperparameters. | | CO2 | R | 1 |
| 4. | Name one optimizer used in deep learning. | | CO2 | R | 1 |
| 5. | Identify the number `of feature maps if a convolution layer outputs a feature map of 16×16×32 size. | | CO3 | U | 1 |
| 6. | Define Convolution. | | CO3 | R | 1 |
| 7. | List one application of RNNs | | CO4 | R | 1 |
| 8. | Identify the bigrams from the following sentence “Deep Learning is an interesting subject”. | | CO4 | U | 1 |
| 9. | State the formula for cosine similarity. | | CO5 | R | 1 |
| 10. | Give an example for Neural Machine Translation. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the architecture of the Rosenblatt perceptron. | | CO1 | U | 3 |
| 12. | Illustrate how bias influences the decision boundary | | CO2 | U | 3 |
| 13. | Compare batch, stochastic, and mini-batch gradient descent | | CO3 | An | 3 |
| 14. | Given a 5×5 input image and a 3×3 filter, compute the convolution output manually for stride = 1 and no padding. | | CO4 | A | 3 |
| 15. | Compare RNN and LSTM. | | CO5 | An | 3 |
| 16. | Explain multi-head attention mechanisms in transformers. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Implement a basic OR gate using the Perceptron Learning Algorithm.  Given:  Learning rate  𝑙𝑟= 0.1  Threshold =0.2  W1=0.3, W2=-0.1 | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the various types of activation functions used in neural networks, highlighting their characteristics and applications. | CO2 | U | 6 |
|  | b. | Explain the variations of Gradient descent to improve learning. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate how CNNs are applied for image classification tasks, detailing each layer’s purpose. | CO3 | A | 8 |
|  | b. | Compute the output image size different layers of the following CNN architecture when applied with an image of size 227 x 227 x 3 to the architecture.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Layer** | **No of Filters/ kernels** | **Filter Size** | **Stride** | **Padding** | **Output image size** | | Input | - | - | - | - |  | | Conv 1 | 15 | 3 x 3 | 2 | - |  | | Max Pool 1 | - | 3 x 3 | 2 | - |  | | Conv 2 | 10 | 5 x 5 | 1 | 2 |  | | Max Pool 2 | - | 2 x 2 | 2 | - |  | | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Explain the architecture of a Long Short Term Memory (LSTM) and its application in time series prediction. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Consider the following corpus of three sentences:   1. I love deep learning 2. I love machine learning 3. I enjoy reading   Using the **bigram language model**, answer the following:  a) Construct the **bigram probability table** for all word pairs in the corpus.  b) Compute the **probability of the sentence** “I love machine” using your bigram model. | CO5 | A | 6 |
|  | b. | Given three short text documents:  D1 = "AI and ML are transforming industries"  D2 = "Machine learning and artificial intelligence change industries"  D3 = "Deep learning is a subset of machine learning"  Compute pairwise Jaccard similarities and identify the two most similar documents. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Analyze the foundation of CBOW architecture and explain how does it differ conceptually from skip-gram models. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the internal architecture of Encoder Decoder model. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the concept of attention mechanisms in sequence modeling. | CO6 | U | 8 |
|  | b. | Describe the limitations of the basic encoder–decoder mode. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Analyze various neural network architectures, including fully connected networks, convolutional neural networks, and recurrent neural networks. |
| **CO2** | Implement perceptron learning algorithms using linear algebra and understand gradient-based learning techniques. |
| **CO3** | Apply convolutional neural networks and transfer learning techniques to solve complex image classification problems using pre-trained models. |
| **CO4** | Demonstrate recurrent neural network models, including LSTMs, to predict time sequences and perform text auto-completion. |
| **CO5** | Evaluate the performance of natural language models and generate accurate word embeddings using Word2Vec and GloVe. |
| **CO6** | Design and develop sequence-to-sequence learning models, incorporating attention mechanisms and transformers for neural machine translation tasks. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2042** | **Duration** | **3hrs** |
| **Course Title** | **THEORY OF COMPUTATION** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the way the computational complexity affects the performance of the system. | | CO1 | R | 1 |
| 2. | Apply union on L1 = {0, 00} and L2 = {1, 00, 01} and compute L1 U L2. | | CO1 | A | 1 |
| 3. | Write a regular expression for the set of all strings of 0’s and 1’s starting with “010”. | | CO2 | A | 1 |
| 4. | Construct a Deterministic finite automata for the set of all strings over ∑ = {a, b} for odd length of a’s. | | CO2 | A | 1 |
| 5. | Write the grammar for the set of all strings over ∑ = {a, b} for even-length palindromes. | | CO3 | A | 1 |
| 6. | Use the given grammar to derive the parse tree for the string “a\*b”.  E→ I | E+E | E\*E | (E)  I→a | b | | CO3 | U | 1 |
| 7. | Eliminate ε-production for the following grammar.  S → aaS |aA | ε  A → bAA | ε | | CO3 | A | 1 |
| 8. | State the rules for defining context-sensitive grammar. | | CO4 | R | 1 |
| 9. | State the instantaneous description of Turing Machine. | | CO5 | R | 1 |
| 10. | State Type 0 language and its corresponding machine in the Chomsky hierarchy. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between the star closure and positive closure over ∑ = {a, b}. | | CO1 | U | 3 |
| 12. | Compare Non-deterministic finite automata and Deterministic finite automata. | | CO2 | U | 3 |
| 13. | Explain ambiguity in grammar with an example. | | CO3 | R | 3 |
| 14. | Differentiate between the Pushdown Automata and Linear Bounded Automata. | | CO4 | U | 3 |
| 15. | Define a Turing Machine with a 7-tuple representation. | | CO5 | R | 3 |
| 16. | Differentiate between the P and NP class problems with an example. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Convert the following regular expression to Non-deterministic finite automata with ε transitions.  (a+b)abb(a+b)\* | CO1 | U | 6 |
|  | b. | Explain the following terminologies with a suitable example.   * String * Alphabet * Language * Grammar and Production | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Convert the given Non-deterministic finite automata into Deterministic finite automata: | CO2 | U | 6 |
|  | b. | Apply minimization concept to reduce the number of states from the given Deterministic Finite Automata. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the following properties of Regular Language with an example:   * Concatenation * Intersection * Homomorphism | CO2 | U | 6 |
|  | b. | Change the automata below to a Left Linear Grammar. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Write the pumping lemma for regular languages with a suitable example. | CO2 | A | 6 |
|  | b. | Consider the given grammar: E->E+E | E-E | E\*E |id.  Apply Leftmost derivation, Rightmost derivation and construct a parse tree for the string “id\*id+id”. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Construct a Push Down Automata for the language L= {02n1n | n>=1}. | CO3 | A | 6 |
|  | b. | Write the pumping lemma for context-free language with a suitable example. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Construct a Turing Machine for the language L = {0n1n | n>=1}. | CO5 | A | 6 |
|  | b. | Construct a Turing Machine for the language L = {anb2n | n>=1}. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Begin with the grammar  S 🡪 DEF | EaG  D 🡪 aD | EaF | aa  E 🡪 bEb | a | D  F 🡪 FD | DF  G 🡪 ε   1. Eliminate ε – production 2. Eliminate unit production 3. Eliminate useless symbols | CO3 | A | 6 |
|  | b. | Convert the grammar G = ({S, A, B, C}, {0, 1}, S, P) with P defined as  S -> 0S | 0A | 1B  A -> 1ABC  B -> 1  C -> ABC  into Chomsky’s and Greibach Normal Forms. | CO3 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Differentiate between the Recursive and Recursively enumerable languages. | CO6 | U | 6 |
|  | b. | Solve the Post Correspondence Problem (PCP) given below:   |  |  |  | | --- | --- | --- | |  | List A | List B | | I | Wi | Xi | | 1 | 10 | 101 | | 2 | 011 | 11 | | 3 | 101 | 011 | | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the concept of languages and grammars. |
| **CO2** | Assess deterministic and non-deterministic finite automata. |
| **CO3** | Analyze pushdown automata from a given context free language or context free grammar. |
| **CO4** | Evaluate the context sensitive grammars. |
| **CO5** | Design turing machine for recursively enumerable language. |
| **CO6** | Develop solutions for undecidability problems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23DC2043** | **Duration** | **3hrs** |
| **Course Title** | **CLOUD COMPUTING FOR DATA ANALYTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define cloud computing. | | CO1 | R | 1 |
| 2. | Identify any two benefits of cloud computing. | | CO1 | R | 1 |
| 3. | List the uses of Azure container service. | | CO2 | R | 1 |
| 4. | Describe the key features of AWS. | | CO2 | R | 1 |
| 5. | Identify the need of Docker in cloud computing. | | CO3 | R | 1 |
| 6. | State the meaning of ‘elasticity of cloud computing’. | | CO3 | R | 1 |
| 7. | State the importance of cloud data warehouse. | | CO4 | R | 1 |
| 8. | List the features of graph databases. | | CO4 | R | 1 |
| 9. | Define ETL in the context of data processing | | CO5 | R | 1 |
| 10. | State the use of Azure ML studio in data analytics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between private cloud and public cloud. | | CO1 | U | 3 |
| 12. | Discuss any three real world use cases where AWS is used. | | CO2 | U | 3 |
| 13. | Differentiate between multi cloud and hybrid cloud. | | CO3 | U | 3 |
| 14. | Classify the different types of cloud storage and list their use cases. | | CO4 | An | 3 |
| 15. | Identify the features of Cloud ETL. | | CO5 | U | 3 |
| 16. | Explain AWS Sagemaker Elastic Architecture. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the various categories of cloud services with examples. Also, mention the benefits of each category. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Distinguish the various cloud services provided by AWS and Azure. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the virtual machine architecture in detail. Also, mention the benefits of virtualization. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A company is planning to implement cloud storage in all its branches which is geographically distributed in different countries. Discuss the challenges and opportunities involved in implementing the distributed computing. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discover any four usecases where AWS Lambda functions can be triggered | CO5 | A | 8 |
|  | b. | Determine the Google cloud functions that can be used in data analytics. | CO5 | A | 4 |
|  |  |  |  |  |  |
| 22. |  | Netflix is using AWS as their hosting platform. During the upgradation phase, shut downing the servers is not a feasible solution for them as it may led to huge loss. Discuss, how continuous delivery and continuous deployment can help in this scenario by citing the benefits. Also, list the steps of CI/CD pipeline. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the architecture of Docker in detail. | CO4 | A | 7 |
|  | b. | Explain the components of Docker. | CO4 | U | 5 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the phases of AWS Sagemaker in detail. | CO6 | An | 8 |
|  | b. | Identify the salient features and capabilities of Jupyter Notebook. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the foundational concepts of cloud computing, including PaaS, Infrastructure as Code, and continuous delivery principles, and demonstrate setting up a Hugo static site. |
| **CO2** | Implement cloud onboarding processes for AWS, GCP, and Azure, and utilize tools like Docker and CircleCI to achieve continuous integration. |
| **CO3** | Analyze virtualization and containerization technologies such as Docker and Kubernetes, including their application in hybrid and multi-cloud environments. |
| **CO4** | Design and implement effective cloud storage solutions, addressing challenges in distributive computing, data governance, and various types of databases. |
| **CO5** | Develop serverless applications using technologies like AWS Lambda and Google Cloud Functions, focusing on ETL processes and solving real-world data integration problems. |
| **CO6** | Evaluate various managed machine learning platforms such as AWS Sagemaker and Google AutoML, and apply these tools to practical data analytics projects. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2044** | **Duration** | **3hrs** |
| **Course Title** | **BIG DATA TOOLS AND TECHNIQUES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the suitable database for unstructured data. | | CO1 | U | 1 |
| 2. | List the three different types of data. | | CO1 | R | 1 |
| 3. | Cite the need for replication | | CO2 | R | 1 |
| 4. | Predict any one advantage of using MapReduce over traditional batch processing. | | CO2 | A | 1 |
| 5. | Identify the scripting language in PIG. | | CO3 | U | 1 |
| 6. | Define UDF’s in PIG. | | CO3 | R | 1 |
| 7. | Define HQL. | | CO4 | R | 1 |
| 8. | Identify command to create a table in Hive QL. | | CO4 | U | 1 |
| 9. | Identify the expansion of “DAG”. | | CO5 | U | 1 |
| 10. | Define social media analytics | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Enumerate any two big data characteristics with suitable examples. | | CO1 | R | 3 |
| 12. | Illustrate the role of name node and data node in Hadoop. | | CO2 | U | 3 |
| 13. | Write any two Pig philosophies and their impact on big data analytics. | | CO3 | A | 3 |
| 14. | Differentiate between internal tables from external tables in Hive. | | CO4 | U | 3 |
| 15. | Sketch the three methods of integrating Spark with Hadoop, clearly labeling each component and its role. | | CO5 | A | 3 |
| 16. | State the key stages involved in text mining process. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze the impact of sharding and replication on the scalability and reliability of a NoSQL database for the scenario:  A global online streaming service stores user profiles, viewing histories, and video metadata in a NoSQL database. During major content releases, millions of users access the platform simultaneously, leading to performance bottlenecks. Additionally, the service must ensure that user data remains accessible even if one or more database servers fail. | CO1 | An | 6 |
|  | b. | Describe the ACID properties with suitable examples. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the Hadoop architecture with a neat diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Predict the role of the following user defined functions and provide its syntax.   1. FILTER 2. LOAD 3. STORE | CO3 | A | 6 |
|  | b. | Differentiate between scalar data types from complex data types in PIG. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Describe the key components such as Thrift Client, Hive Server, JDBC/ODBC client and HIVE services and HIVE driver, Meta Storage in the HIVE architecture with a neat diagram. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the components of Apache Spark with examples highlighting their use in data processing workflows. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Identify the HDFS commands for the following operation:   1. To create a new directory in HDFS. 2. To Lists all files and directories in HDFS. 3. To copy data from local file system to HDFS. | CO3 | A | 6 |
|  | b. | Analyze the impact of spark’s lazy evaluation on workflow execution and performance optimization. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the four types of file formats in HIVE. | CO4 | U | 8 |
|  | b. | Identify the type of NoSQL database for the following scenarios:   1. A ride-sharing app needs to store the real-time location of vehicles for fast access. 2. An e-commerce platform stores product catalogs with variable attributes in JSON-like documents. | CO1 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the role of text mining and sentiment analysis in extracting insights from the customer feedback for the given scenario.  A leading smartphone company recently launched a new model. Customers have been posting reviews, comments, and tweets about the phone’s features, battery life, and camera performance on various social media platforms. The company wants to understand overall customer satisfaction, common complaints, and positive feedback to improve its product and marketing strategy. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the core concept and storage solutions of Big Data. |
| **CO2** | Illustrate the key components of Hadoop architecture. |
| **CO3** | Apply knowledge of Pig architecture and data model. |
| **CO4** | Analyze Hive, Hive QL for data definition and manipulation. |
| **CO5** | Design data processing solutions using Spark. |
| **CO6** | Evaluate social media data, perform sentiment analysis, and assess mobile analytics |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2046** | **Duration** | **3hrs** |
| **Course Title** | **AGILE SOFTWARE DEVELOPMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State User Story in agile. | | CO1 | R | 1 |
| 2. | Define Refactoring. | | CO1 | R | 1 |
| 3. | State the main goal of agile project management. | | CO2 | R | 1 |
| 4. | Define Agile Estimation. | | CO2 | R | 1 |
| 5. | State burn-down chart with a neat sketch. | | CO3 | R | 1 |
| 6. | Define acceptance test. | | CO3 | R | 1 |
| 7. | Name one tool commonly used for unit testing in TDD. | | CO4 | R | 1 |
| 8. | State the goal of acceptance testing. | | CO4 | R | 1 |
| 9. | List the needs of refactoring in agile development. | | CO5 | R | 1 |
| 10. | Define Agility. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the use of user stories and regular backlog refinement that helps agile teams to manage changing requirements and improve project outcomes for the given scenario.  **Scenario:** During a sprint, your agile team faces challenges with frequent changes in user requirements, resulting in misunderstandings and rework. | | CO1 | An | 3 |
| 12. | Explain the phase planning in agile project. | | CO2 | U | 3 |
| 13. | Explain sprint planning and retrospective in scrum. | | CO3 | U | 3 |
| 14. | Explain the role of automated build tools in supporting the agile tester. | | CO4 | U | 3 |
| 15. | Explain the benefits of version control in agile. | | CO5 | U | 3 |
| 16. | Differentiate between RAD and Agile. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the interconnected roles of Test-Driven Development (TDD), and Pair Programming in maintaining code quality and delivering value in agile environment. | CO1 | A | 8 |
|  | b. | Describe the major agile framework Extreme Programming (XP). | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. |  | Describe the step-by-step process followed in Sprint-level Estimation during agile sprint planning. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the following in Scrum framework with neat diagram.   1. Product Backlog 2. Sprint Backlog 3. Daily Scrum | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the implementation of regression testing with relevant example. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain Dependency Inversion principles in agile design. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the key stages involved in a typical CI/CD pipeline. | CO5 | An | 7 |
|  | b. | Explain the risk- based testing implementation framework. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 23. |  | Analyze the key challenges faced by agile teams operating within distributed environments. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the risk and mitigation of agile software development. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Apply the principles and practices of Agile methods in software development |
| **CO2** | Organize the initial product backlog items as user stories and order the product backlog. |
| **CO3** | Estimate the size of the backlog items and perform sprint planning. |
| **CO4** | Evaluate the testing activities within an Agile project. |
| **CO5** | Design automated build tools for continuous integration using agile design principles. |
| **CO6** | Construct agile practices when multiple teams are working on a single project. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23DC2047** | **Duration** | **3hrs** |
| **Course Title** | **OPTIMIZATION METHODOLOGIES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the objective function for the following scenario: A farmer mixes two brands P and Q of cattle feed. Brand P, costing Rs 250 per bag, contains 3 units of nutritional element A, 2.5 units of element B and 2 units of element C. Brand Q costing Rs 200 per bag contains 1.5 units of nutritional element A, 11.25 units of element B, and 3 units of element C. The minimum requirements of nutrients A, B and C are 18 units, 45 units and 24 units respectively. | | CO1 | U | 1 |
| 2. | Name the algorithm that repeatedly and simultaneously maintain the search effort inside the feasible search region. | | CO1 | R | 1 |
| 3. | List the two methods used for Artificial Variable Technique for a Linear Programming Problem. | | CO2 | U | 1 |
| 4. | Name the variable that is added to an inequality constraint to transform it into an equality constraint. | | CO2 | R | 1 |
| 5. | Name the method used for an assignment problem in an integer programming model. | | CO3 | R | 1 |
| 6. | Identify whether the given assignment problem is balanced or not.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Persons/  Jobs | 1 | 2 | 3 | 4 | | A | 10 | 12 | 19 | 11 | | B | 5 | 10 | 7 | 8 | | C | 12 | 14 | 13 | 11 | | D | 8 | 12 | 11 | 9 | | | CO3 | U | 1 |
| 7. | List any two techniques used in unconstrained optimization for a nonlinear programming problem. | | CO4 | U | 1 |
| 8. | Identify whether the function is concave or convex.  f(x) = 100 – x2 | | CO4 | R | 1 |
| 9. | List any two applications of Dynamic Programming. | | CO5 | R | 1 |
| 10. | Define Genetic Algorithm. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Construct the Linear Programming Problem for the following:  A cottage industry manufactures pedestal lamps and wooden shades, each requiring the use of a grinding/cutting machine and a sprayer. It takes 2 hours on grinding/cutting machine and 3 hours on the sprayer to manufacture a pedestal lamp. It takes 1 hour on the grinding/cutting machine and 2 hours on the sprayer to manufacture a shade. On any day, the sprayer is available for at the most 20 hours and the grinding/cutting machine for at the most 12 hours. The profit from the sale of a lamp is Rs 5 and that from a shade is Rs 3. | | CO1 | A | 3 |
| 12. | Illustrate the following linear programming problem graphically.  Maximize z = 4x + y  subject to x + y ≤ 50  3x + y ≤ 90  x, y ≥ 0 | | CO2 | U | 3 |
| 13. | Explain the steps of Vogel’s Approximation method for transportation problem. | | CO3 | U | 3 |
| 14. | Determine the Hessian matrix value for the following NLPP:  z = 6x + 5y  subject to x + 5y = 7  x, y ≥ 0 | | CO4 | A | 3 |
| 15. | Deduce the longest common subsequence for the given two sequences:  Sequence 1: ABCDGH  Sequence 2: AEDFHR | | CO5 | An | 3 |
| 16. | Differentiate between Genetic Algorithm and Non-Traditional Algorithms. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify the different types of optimization algorithms and categorize them based on their characteristics and applications. | CO1 | U | 6 |
|  | b. | Determine the dual of the following primal linear programming problem.  Minimize z = x1 - 3x2 - 2x3  subject to 3x1 - x2 + 2x3 ≤ 7  2x1 – 4x2 ≥ 12  -4x1 + 3x2 + 8x3 =10  x1, x2 ≥ 0, x3 - unrestricted | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Apply the simplex method to find the optimal solution of the given maximization problem.  Maximize z = 40x1 + 30x2  subject to x1 + x2 ≤ 12  2x1 + x2 ≤ 16  x1, x2 ≥ 0 | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Determine the optimum assignment schedule for the problem of assigning 5 jobs to 5 persons. The assignment costs are given as follows:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Persons** | **Jobs** | | | | | | **1** | **2** | **3** | **4** | **5** | | **A** | 8 | 4 | 2 | 6 | 1 | | **B** | 0 | 9 | 5 | 5 | 4 | | **C** | 3 | 8 | 9 | 2 | 6 | | **D** | 4 | 3 | 1 | 0 | 3 | | **E** | 9 | 5 | 8 | 9 | 5 | | CO3 | A | 6 |
|  | b. | Solve the following transportation problem using the Least Cost Cell method and North west corner method for the XYZ Inc. that has two factories with weekly production rates of 40 & 20 widgets. These widgets must be shipped to 3 warehouses that have a demand of 25, 10 and 25 units. The cost to ship between each location is given in the table below.   |  |  |  |  | | --- | --- | --- | --- | | **Factory** | **Warehouse 1** | **Warehouse 2** | **Warehouse 3** | | **A** | 550 | 300 | 400 | | **B** | 350 | 300 | 100 | | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Determine the optimal value for the given function up to 4 iterations with a tolerance of ∆ = 0.1 using the Dichotomous method.  Maximize f(x) = 4x, 0 ≤ x ≤ 2  4 – x, 2 ≤ x ≤ 4 | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Solve the following NLPP using Lagrange Method.  Maximize z = 4x12 + 2x22 + x32 – 4x1x2  subject to x1 + x2 + x3 = 15  2x1 - x2 + 2x3 = 20  x1, x2, x3 ≥ 0 | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Apply the forward recursion to determine the shortest route and shortest distance from node 1 to node 10 for the given network diagram. | CO5 | A | 6 |
|  | b. | Determine the optimal sequence that minimizes the total elapsed time (in hours) required to complete the 9 tasks on 2 machines and determine the idle time on machines 1 & 2.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Task** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | Machine 1 | 2 | 5 | 4 | 9 | 6 | 8 | 7 | 5 | 4 | | Machine 2 | 6 | 8 | 7 | 4 | 3 | 9 | 3 | 8 | 11 | | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Solve the following NLPP using Karush Kuhn Tucker method.  Maximize z = 10x + 4y -2x2 -y2  subject to 2x + y ≤ 5  x, y ≥ 0 | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Apply the genetic algorithm to determine the maximization of the function f(x) = x2 with the minimum and maximum value as (0,31) and the random 4 populations as {01100, 11001, 00101, 10011}, | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Formulate optimization problems |
| **CO2** | Solve linear programming problems |
| **CO3** | Apply integer programming techniques to real world problems. |
| **CO4** | Demonstrate the non - linear programming methods |
| **CO5** | Implement the optimization methodologies for dynamic programming applications |
| **CO6** | Illustrate optimization solutions using Genetic algorithms |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23DC2048** | **Duration** | **3hrs** |
| **Course Title** | **SYSTEM SOFTWARE AND COMPILER DESIGN** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two types of system software. | | CO1 | R | 1 |
| 2. | Identify the purpose of Bootstrap Loader. | | CO1 | U | 1 |
| 3. | Identify the regular expression to recognize all identifiers. | | CO2 | U | 1 |
| 4. | Identify four possible strings for the given regular expression: (ab)\*a | b\* | | CO2 | U | 1 |
| 5. | Find all the LR (0) items for the production S→AB. | | CO3 | U | 1 |
| 6. | Identify the FIRST of the following grammar: for A  S → A B  A → a A | ε  B → b B | c | | CO3 | U | 1 |
| 7. | Identify the two types of attributes used in syntax-directed definitions. | | CO4 | U | 1 |
| 8. | Identify the characteristics that make a grammar an S-attributed definition. | | CO4 | U | 1 |
| 9. | Identify the Three-Address Code statement for the expression x = a + b \* c. | | CO5 | U | 1 |
| 10. | Identify the input to a code generator in a compiler. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between compiler and interpreter. | | CO1 | U | 3 |
| 12. | Show that the following grammar is ambiguous: S → S + S | S \* S | a using the input string a + a \* a. | | CO2 | U | 3 |
| 13. | Construct the initial item set for the following grammar using the LALR (Look-Ahead LR) parsing method.  S’🡪 S  S🡪AS ∣ b ∣ SA  A🡪Aa | | CO3 | A | 3 |
| 14. | Illustrate the difference between synthesized and inherited attributes with suitable examples. | | CO4 | U | 3 |
| 15. | Explain the two types of type checking with example. | | CO5 | U | 3 |
| 16. | Illustrate the way constant folding is performed during peephole optimization with a code snippet. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the role of the various Assembler Directives in memory organization. | CO1 | U | 6 |
|  | b. | Explain the major Loader Design Options like Linkage Editor, Dynamic Linking, and Bootstrap Loader. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the phases of a compiler using the statement:  Result = MarksObtained \* 100 / MaxMarks  to show its transformation through each phase up to the final target code. Where Result and MaxMarks are real; and Marks Obtained is an integer | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Construct the SLR Parsing table for the following grammar and parse the string “a+a\*a”.  E → E + T | T  T → T \* F | F  F → a | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Construct an annotated parse tree for the input expression: (7 - 2) + 4 \* 3 according to the following syntax-directed definition:   | **Production** | **Semantic Rule** | | --- | --- | | E → E + T | E.val := E.val + T.val | | E → E - T | E.val := E.val - T.val | | E → T | E.val := T.val | | T → T \* F | T.val := T.val \* F.val | | T → F | T.val := F.val | | F → (E) | F.val := E.val | | F → num | F.val := num.val | | CO4 | A | 8 |
|  | b. | Differentiate between L-attributed and S-attributed definitions in terms of attribute flow. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. |  | Construct three address code, quadruples, triples, indirect triples, syntax tree and DAG for the expression **x= a+ (b\*c)/(a-b)\*c.** | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Construct a minimized Deterministic Finite Automaton (DFA) for the regular expression:  (a | b) \*abb. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Construct the Canonical LR (CLR (1)) parsing table for the following grammar and parse the input string “abab”.  S → AA  A → aA|b | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the key issues in designing a code generator, including the input to the code generator, the structure of the target program, memory management, instruction selection, register allocation, and evaluation order. | CO6 | U | 6 |
|  | b. | Construct the basic blocks and flow graph for the given sequence of Three-Address-Code and analyze the loop structure present in the graph.  1) i=1  2) j=1  3) t1 = 10 \* i  4) t2 = t1 + j  5) t3 = 8 \* t2  6) t4 = t3 - 88  7) a[t4] = 0.0  8) j = j + 1  9) if j <= goto (3)  10) i = i + 1  11) if i <= 10 goto (2)  12) i = 1  13) t5 = i - 1  14) t6 = 88 \* t5  15) a[t6] = 1.0  16) i = i + 1  17) if i <= 10 goto (13) | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the algorithms and data structures used for assemblers, macro processors, and loaders |
| **CO2** | Illustrate the functionality of compilation phases, design regular expressions, and construct finite automata for programming languages. |
| **CO3** | Demonstrate various top-down and bottom-up parsers. |
| **CO4** | Analyze the type systems, type checking and symbol tables, and formulate error messages |
| **CO5** | Develop and assess various intermediate representations in compiler design. |
| **CO6** | Apply advanced techniques for code generation and optimization |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2049** | **Duration** | **3hrs** |
| **Course Title** | **NATURAL LANGUAGE PROCESSING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the significance of the regular expression ^a | | CO1 | R | 1 |
| 2. | Predict the bigram probability *P(would/I)* from the given corpus:  <s> I like coffee </s>  <s> Do you like coffee </s>  <s> I would like a cup </s>  <s> Why would I complain </s> | | CO1 | A | 1 |
| 3. | Predict the output of the words "better" and "best" when processed through a lemmatization algorithm. | | CO2 | R | 1 |
| 4. | List the components of the Hidden Markov Model. | | CO2 | R | 1 |
| 5. | Show the three grammatical constituents for the given sentence:  *‘The little boy with a red balloon played near the park gate’.* | | CO3 | A | 1 |
| 6. | Identify the key difference between Context-Free Grammars and Dependency Grammars. | | CO3 | U | 1 |
| 7. | Calculate the probability of the following parse tree for the sentence “*Dogs chase cats*”, using the rule probabilities below: | | CO4 | U | 1 |
| 8. | Predict the lexical relationship between the word *‘school’* in the following sentences:   1. *The school opened its new building last week.* 2. *The school won the intercollege football championship.* | | CO4 | R | 1 |
| 9. | Suggest an appropriate machine learning approach for identifying relationships between entities in biomedical text. | | CO5 | U | 1 |
| 10. | Identify the major challenges affecting the performance of information retrieval-based question answering systems. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Apply the Levenshtein approach to calculate the edit distance required to transform the word ‘INTENTION’ into ‘EXECUTION’ by constructing a two-dimensional array. | | CO1 | A | 3 |
| 12. | State how Hidden Markov Models (HMMs) are applied in Part-of-Speech (POS) tagging tasks in Natural Language Processing. | | CO2 | A | 3 |
| 13. | Compare statistical parsing and rule-based parsing approaches, highlighting their advantages and limitations in syntactic analysis. | | CO3 | An | 3 |
| 14. | Explain how WordNet represents semantic relations such as synonymy, antonymy, and hyponymy among word senses. | | CO4 | U | 3 |
| 15. | Discuss the challenges and ethical considerations involved in deploying Large Language Models for real-world NLP applications. | | CO5 | An | 3 |
| 16. | Write three applications of text classification. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate the spell-checker algorithms commonly used in natural language processing. Apply the Levenshtein dynamic programming approach with a 2D array to calculate the edit distance to transform “DEVELOPMENT” (row-wise) and “DEPLOYMENT” (column-wise). Assume the cost for each edit operation to be 1. | U | CO1 | 6 |
|  | b. | Estimate the bigram probability of the test sentence: *<s>I love machine learning algorithms </s>,* by applying add-one smoothing for the training corpus with four sentences:  *<s> I love natural language processing </s>*  *<s> The cat is sitting on the mat</s>*  *<s> Machine learning algorithms are powerful</s>*  *<s> NLP models analyze linguistic patterns</s>* | An | CO1 | 6 |
| 18. | a. | Estimate the appropriate POS tags for the given sentence: "She reads books."  Transition Probabilities:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **From/To** | **PRP** | **VBZ** | **DT** | **NN** | | **PRP** | 0.0 | 0.8 | 0.1 | 0.1 | | **VBZ** | 0.0 | 0.0 | 0.6 | 0.4 | | **DT** | 0.0 | 0.0 | 0.0 | 1.0 | | **NN** | 0.0 | 0.2 | 0.0 | 0.0 |   Emission Probabilities:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Word** | **PRP** | **VBZ** | **DT** | **NN** | | **She** | 1 | 0 | 0 | 0 | | **reads** | 0 | 0.9 | 0.1 | 0 | | **books** | 0 | 0 | 0.3 | 0.7 | | CO2 | A | 6 |
|  | b. | Summarize the different types of morphemes based on their word meanings and properties with suitable examples. | CO2 | U | 6 |
| 19. |  | Apply the CKY parsing algorithm to parse the sentence “the man read a book”, using the following grammar rules:  S → NP VP  NP → Det NOM  NOM → Noun  NOM → Noun NOM  VP → Verb  VP → Verb NP  Det → this | that | a | the  Noun → man | book | apple | teacher  Verb → read | write | eat | CO3 | A | 12 |
| 20. | a. | Illustrate how TF-IDF represents words as weighted vectors. Include an example to show how it highlights important terms. | CO4 | An | 6 |
|  | b. | Examine the working of Word2Vec in learning word embeddings. How does it capture semantic similarity between words? | CO4 | An | 6 |
| 21. |  | Discuss the algorithms (Naive Bayes Classifier, Decision Trees) used for Word Sense Disambiguation (WSD). Discuss supervised, unsupervised, and knowledge-based approaches, and illustrate how one of these algorithms determines the correct sense of an ambiguous word with a suitable example. Also, analyze the advantages and limitations of each approach. | CO5 | U | 12 |
| 22. |  | Apply the Naive Bayes classifier to categorize the following test review as *Positive* or *Negative*. Show your approach with a complete step-by-step explanation (preprocessing, vocabulary, word counts, class priors, likelihoods with Laplace smoothing, posterior scores and final decision).  Class = Positive:  1. "good product works well"  2. "excellent build quality"  3. "works well and looks good"  Class = Negative:  1. "poor quality broke quickly"  2. "not worth money"  3. "poor performance and bad battery" Test document:  "good quality and works"  Classify the test document and show all intermediate calculations. | CO6 | A | 12 |
| 23. |  | Compare the working of Top-Down and Bottom-Up Parsing by applying both approaches to parse the sentence: *"The boy read the book"* using the following grammar:  S → NP VP  NP → Det N  VP → V NP  Det → "The" | "A"  N → "boy" | "book"  V → "read"  Show the step-by-step derivations and parse tree construction for both parsing strategies. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the relationship extraction process in NLP with an example. | CO6 | U | 6 |
|  | b. | Examine how Natural Language Processing contribute to enhancing the performance of chatbots and dialogue systems. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the linguistic components of language models in text processing |
| **CO2** | Analyze the sequence labeling for parts of speech and named entities |
| **CO3** | Demonstrate the parse tree construction with syntactic and statical parsing |
| **CO4** | Examine vector semantics and embeddings in language processing |
| **CO5** | Implement computational semantics and semantic parsing techniques |
| **CO6** | Develop real time applications of natural language processing |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2050** | **Duration** | **3hrs** |
| **Course Title** | **MLOps** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define MLOps and its main objective. | | CO1 | U | 1 |
| 2. | List any two challenges of traditional software development. | | CO1 | R | 1 |
| 3. | State the importance of source-code management in MLOps. | | CO2 | R | 1 |
| 4. | Name any two APIs used for model serving in MLOps. | | CO2 | R | 1 |
| 5. | Identify one key metric used for model interpretability. | | CO3 | U | 1 |
| 6. | Identify the role of feature engineering in a machine-learning pipeline. | | CO3 | R | 1 |
| 7. | State the role of Docker in the MLOps environment. | | CO4 | U | 1 |
| 8. | Define CI/CD in the context of MLOps. | | CO4 | R | 1 |
| 9. | Identify the role of data lineage in ML systems. | | CO5 | U | 1 |
| 10. | Identify any two differences between canary and blue-green deployment strategies. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the evolution of MLOps from traditional software development practices. | | CO1 | An | 3 |
| 12. | Discuss the way business problem analysis aids in defining ML pipelines. | | CO2 | U | 3 |
| 13. | Analyze the impact of data preprocessing and feature engineering on model performance. | | CO3 | An | 3 |
| 14. | Describe the way containerization using Docker enhances model portability in MLOps. | | CO4 | U | 3 |
| 15. | Analyze the way data lineage and provenance management ensure trust in ML systems. | | CO5 | An | 3 |
| 16. | Describe the role of governance, security, and compliance in monitoring ML systems | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A traditional retail company is moving to automate its operations using ML models for demand forecasting. They currently face challenges with infrastructure, model versioning, and team coordination. Analyze the way MLOps workflow can solve these challenges and sketch an implementation roadmap. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the importance of business problem analysis and tool selection in ML pipeline design. | CO2 | U | 6 |
|  | b. | A fintech startup has structured and unstructured data. Compare approaches to process these data types in ML pipelines. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | A healthcare provider is deploying a patient-risk model. Evaluate the way feature engineering, model selection, and evaluation metrics affect interpretability and deployment. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | List three common deployment strategies for ML models and state their advantages and limitations.. | CO4 | U | 6 |
|  | b. | A company needs to deploy an ML model for real-time predictions across multiple regions. Apply containerization and microservices concepts to design a scalable deployment strategy. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | An e-commerce platform runs recommendation ML models. Apply monitoring techniques to detect latency issues and model drift, and propose actions to maintain reliable operations. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the importance of data validation, lineage, and provenance in ensuring ML model trustworthiness. | CO5 | U | 6 |
|  | b. | A dataset has missing and inconsistent entries. Explain the rules for validation to maintain completeness and consistency. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. |  | A predictive maintenance ML model shows drift in production. Analyze the way testing, securing, and maintaining the ML solution prevents accuracy degradation and ensures reliability. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compare canary vs. blue-green deployment for an ML-based recommendation engine that serves millions of users. | CO6 | An | 6 |
|  | b. | Explain measures to ensure governance, security, and compliance for production ML systems. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the concept, workflow and structure of MLOps. |
| **CO2** | Formulate ML models for pipeline deployment and for external business systems that are more complex and less standardized. |
| **CO3** | Design an ML production end-to-end system. |
| **CO4** | Evaluate a model baseline, manage concept drift, and prototype the development, deployment, and continuous improvement of a production-grade ML application. |
| **CO5** | Formulate the data lifecycle using tools for data lineage and provenance metadata and build data pipelines by collecting, cleaning, and validating datasets. |
| **CO6** | Apply best practices and progressive delivery techniques to maintain a leading operating production system. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2051** | **Duration** | **3hrs** |
| **Course Title** | **DATA AND INFORMATION SECURITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Describe the role of people in maintaining information system security. | | CO1 | U | 1 |
| 2. | Define availability in the CIA triad. | | CO1 | R | 1 |
| 3. | State the purpose of an Access Control Matrix. | | CO2 | R | 1 |
| 4. | List the three main components of computer security. | | CO2 | R | 1 |
| 5. | Identify the main purpose of the Diffie–Hellman algorithm. | | CO3 | U | 1 |
| 6. | Define symmetric encryption. | | CO3 | R | 1 |
| 7. | Describe the meaning of “non-repudiation” in the context of digital signatures. | | CO4 | U | 1 |
| 8. | Define authentication. | | CO4 | R | 1 |
| 9. | Explain the goal of IP Security (IPSec). | | CO5 | U | 1 |
| 10. | Identify one difference between SSL and TLS. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain how people, processes, and technology components of an information system contribute differently to security. | | CO1 | An | 3 |
| 12. | Explain the need for security in business organizations. | | CO2 | U | 3 |
| 13. | Distinguish between public key cryptography and private key cryptography with examples. | | CO3 | An | 3 |
| 14. | Explain how Kerberos ensures mutual authentication between clients and servers. | | CO4 | U | 3 |
| 15. | Differentiate between Transport Mode and Tunnel Mode in IPSec. | | CO5 | An | 3 |
| 16. | Describe the process of SET authorization and payment. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Analyze the evolution of information security, highlighting key milestones that have led to modern cybersecurity. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe six common types of threats and attacks and give a real-life scenario for each. | CO2 | U | 6 |
|  | b. | Explain the Access Control Matrix and illustrate how it can be used to define permissions for users and processes. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Apply public-key cryptography for the given scenario:  A multinational company is establishing a secure communication link between its two executives, Alice and Bob, working from different locations. To maintain confidentiality, they decide to use the Diffie–Hellman Key Exchange algorithm to generate a shared secret key for encryption. Calculate the public keys that Alice and Bob exchange, and determine the shared secret key they both generate independently.  The company selects:  p=29  g=2  Private keys chosen:  a=10  b=12 | CO3 | A | 8 |
|  | b. | Describe the working of digital signature with the help of a neat diagram. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Apply the concept of X.509 certificates to explain how trust is established between two communicating systems. | CO4 | A | 8 |
|  | b. | Analyze the advantages and limitations of using Kerberos for enterprise-level authentication. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the key components of S/MIME and explain how each contributes to e-mail security. | CO5 | An | 8 |
|  | b. | Analyze the importance of Security Associations (SA) in the IPSec framework. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. |  | Explain how organizations balance security and access requirements while implementing the Security SDLC. Illustrate with an example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working of DES with a small example of encryption of a plaintext block. | CO3 | U | 6 |
|  | b. | Describe the critical characteristics of Information Security and give real-world examples where each could be compromised. | CO1 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Apply the SSL handshake process to illustrate how a web client and server establish a secure connection. | CO6 | A | 8 |
|  | b. | Differentiate between the SSL Record Protocol and the SSL Handshake Protocol. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Implement the foundational concepts of data and information security. |
| **CO2** | Analyze the need for security and understand various security policies. |
| **CO3** | Apply encryption techniques and key management strategies. |
| **CO4** | Implement digital signature and authentication schemes. |
| **CO5** | Demonstrate various security practices and system security standards. |
| **CO6** | Assess the web security protocols for E - Commerce applications. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23DC2053** | **Duration** | **3hrs** |
| **Course Title** | **DISTRIBUTED REAL TIME SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Real Time System. | | CO1 | R | 1 |
| 2. | List any two characteristics of real time systems. | | CO1 | R | 1 |
| 3. | Differentiate between hard and soft real time systems. | | CO2 | U | 1 |
| 4. | State the finite state machine in distributed systems. | | CO2 | R | 1 |
| 5. | List any one function of the Real Time Operating System (RTOS). | | CO3 | R | 1 |
| 6. | Define Middleware in Distributed Real Time Systems. | | CO3 | R | 1 |
| 7. | Give an example of a real time programming language. | | CO4 | U | 1 |
| 8. | State one challenge in Distributed Embedded Real Time Systems. | | CO4 | R | 1 |
| 9. | Define Priority based scheduling. | | CO5 | R | 1 |
| 10. | Infer any one phase of Software Development Life Cycle (SDLC) for real-time system design. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch basic architecture of a real time system. | | CO1 | A | 3 |
| 12. | State the role of processor and memory in real-time systems. | | CO2 | R | 3 |
| 13. | Compare time triggered and event triggered systems with examples. | | CO3 | U | 3 |
| 14. | Differentiate between a general purpose OS and a real time OS. | | CO4 | U | 3 |
| 15. | Describe clock driven and priority based scheduling. | | CO5 | U | 3 |
| 16. | List the uses of UML in real-time system design. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the characteristics and classification of real-time systems with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Analyze the challenges faced in distributed real time embedded systems. | CO2 | An | 6 |
|  | b. | Explain the role of real time communication in distributed systems. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain task and memory management in Real Time Operating System. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the architecture and implementation of real time middleware. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the various scheduling techniques for periodic, aperiodic, and sporadic tasks. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the multiprocessor and distributed scheduling approaches with examples. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain transport layer and design techniques for real time systems. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the key design considerations and implementation challenges in distributed real time system development. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL M – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the need for real time systems. |
| **CO2** | Demonstrate the various models and challenges in distributed real time systems. |
| **CO3** | Analyze the need for real time operating systems. |
| **CO4** | Illustrate the different approaches used in distributed real time systems and the middleware. |
| **CO5** | Analyze the various scheduling methodologies used in real time systems. |
| **CO6** | Synthesize the need of SDLC in Real time systems. |



END SEMESTER EXAMINATION – NOV / DEC 2025

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| **Course Code** | **23DC2054** | **Duration** | **3hrs** |
| **Course Title** | **CRYPTOGRAPHY AND NETWORK SECURITY** | **Max. Marks** | **100** |

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| **Q.**  **No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the key difference between a stream cipher and a block cipher. | | CO1 | R | 1 |
| 2. | State one limitation of Rail fence Cipher algorithm. | | CO1 | U | 1 |
| 3. | Expand ECB & CBC. | | CO2 | R | 1 |
| 4. | Name any two methods in hashing to ensure message integrity. | | CO2 | R | 1 |
| 5. | Define padding in Merkle-Damgrad construction. | | CO3 | R | 1 |
| 6. | State the primary advantage of hash-based signatures. | | CO3 | U | 1 |
| 7. | List any two of the OWASP top 10 vulnerability. | | CO4 | R | 1 |
| 8. | Expand SSL and TLS. | | CO4 | U | 1 |
| 9. | Name the five pillars of Cisco zero trust capabilities. | | CO5 | R | 1 |
| 10. | State any two advantages of AI for security. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between Symmetric and Asymmetric Encryption. | | CO1 | U | 3 |
| 12. | List any three key features of HMAC. | | CO2 | R | 3 |
| 13. | State the properties of congruences in Arithmetic Modulo. | | CO3 | R | 3 |
| 14. | Define TLS and explain its importance in network security. | | CO4 | U | 3 |
| 15. | Describe zero trust reference architecture | | CO5 | R | 3 |
| 16. | Differentiate ‘public blockchains’ from ‘private blockchains’. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain with example, the working of Public Key Cryptography in the encryption and decryption process. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working of Merkle Damgard construction method in building a secure hash function. | CO2 | R | 6 |
|  | b. | Explain the process of CBC in providing confidentiality and authentication of messages. | CO2 | U | 6 |
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| 19. |  | Describe the X.509 certificate format in detail, highlighting its key fields. Also, explain the process and importance of certificate revocation. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the IPSec Security Policy and discuss its key components, including Security Association (SA) and Security Policy Database (SPD). | CO4 | U | 6 |
|  | b. | Describe the characteristics of IDS and explain its types. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Describe in detail the post quantum cryptography. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain with sketch the Diffie-Hellman key exchange algorithm. | CO3 | U | 6 |
|  | b. | Alice and Bob use the Diffie- Hellman key exchange technique with a common prime q=353 and a primitive root **α = 3.**  Find   1. Public key of Alice, YA ( private key XA= 97) 2. Public key of Bob, YB (private key XB=233) 3. Shared secret key between Alice and Bob. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Describe the RSA algorithm covering the aspects of Key generation, Encryption and Decryption processes. Explain with an example. | CO4 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the key requirements and importance of lightweight cryptography in IoT. Also, describe the five essential steps to prevent cyberattacks on IoT systems. | CO6 | U | 6 |
|  | b. | In a smart city, various IoT devices are deployed for automation and efficiency. However, cyber threats target different aspects of the IoT ecosystem. Consider the following scenarios:   * A hacker gains access to a smart home’s security cameras and locks. * Attackers alter factory sensors, leading to incorrect temperature readings in a manufacturing plant. * Unauthorized access to a hospital’s IoT-connected patient monitoring devices exposes sensitive health data.   Analyze these scenarios and explain the three primary targets of attack in IoT systems. Discuss how each attack could impact security, privacy, and system functionality. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the security issues and identify the suitable cryptographic algorithms. |
| **CO2** | Apply security algorithms to achieve confidentiality, integrity and availability. |
| **CO3** | Illustrate the importance of network security in the context of various attacks. |
| **CO4** | Develop secure electronic applications using digital signatures. |
| **CO5** | Construct combinations of cryptographic algorithms for securing network applications. |
| **CO6** | Analyze the advancements in network security implementations |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2001** | **Duration** | **3hrs** |
| **Course Title** | **TEXT AND SPEECH ANALYTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Natural Language Processing (NLP). | | CO1 | R | 1 |
| 2. | Identify the purpose of regular expressions in NLP. | | CO1 | R | 1 |
| 3. | Define sentiment classification. | | CO2 | R | 1 |
| 4. | List any one popular word embeddings used in NLP. | | CO2 | R | 1 |
| 5. | Name the process of connecting text mentions of entities to entries in a knowledge base. | | CO3 | R | 1 |
| 6. | State any one evaluation metric of dialogue systems. | | CO3 | R | 1 |
| 7. | List three speech sound classifications. | | CO4 | R | 1 |
| 8. | Identify any one phonetic resource. | | CO4 | R | 1 |
| 9. | State any one application of CTC in ASR. | | CO5 | R | 1 |
| 10. | State any one application of HMM-DNN models in ASR | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between stemming and lemmatization with examples. | | CO1 | U | 3 |
| 12. | Apply a Transformer block to a sentence for representation. | | CO2 | A | 3 |
| 13. | Differentiate between knowledge based and Information retrieval based Question Answering systems. | | CO3 | U | 3 |
| 14. | Compare articulatory with acoustic phonetics. | | CO4 | U | 3 |
| 15. | Explain the process of Text to Speech (TTS) converts text into speech. | | CO5 | U | 3 |
| 16. | Explain the purpose of multilingual ASR systems. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Apply tokenization, stopword removal, and lemmatization to a sample text paragraph and explain the changes at each step. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the need for text normalization in NLP. | CO1 | U | 6 |
|  | b. | Explain the effect of language ambiguity on text processing. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the performance of RNN and Transformer models for long-text sentiment analysis | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the main components of a dialogue system. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the process of producing speech sounds through articulatory phonetics. | CO4 | U | 6 |
|  | b. | Describe the significance of prosody in human communication. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the role of MFCC coefficients in speech feature extraction. | CO5 | U | 6 |
|  | b. | Explain the use of Word Error Rate in evaluating Automatic Speech Recognition(ASR). | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the effect of speech distortion on recognition accuracy. | CO5 | An | 6 |
|  | b. | Compare log spectral and cepstral distances in ASR evaluation | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the superiority of deep neural networks over traditional HMM based speech systems. | CO6 | A | 6 |
|  | b. | Explain the various challenges in training deep models for speech recognition. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Distinguish the existing and emerging applications in text and speech processing |
| **CO2** | Analyze the deep learning architecture for sentiment classification and sequence processing |
| **CO3** | Apply modern techniques to build question answering, chatbots and dialogue systems |
| **CO4** | Demonstrate the speech sounds and phonetic transcription for classification |
| **CO5** | Evaluate the automatic speech recognition tasks and pattern comparison techniques |
| **CO6** | Assess the deep models for automatic speech recognition and text - to - speech analytics |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2004** | **Duration** | **3hrs** |
| **Course Title** | **EDGE COMPUTING AND AI** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the layer serving as an interface between end devices and the cloud | | CO1 | U | 1 |
| 2. | Identify the purpose of MEC in Edge AI. | | CO1 | R | 1 |
| 3. | State the primary function of an Edge Device in Edge AI. | | CO2 | R | 1 |
| 4. | Identify the layer responsible for centralized data processing in Edge AI. | | CO2 | R | 1 |
| 5. | Identify the purpose of EEoI in Edge AI applications. | | CO3 | U | 1 |
| 6. | Define model pruning for AI model optimization. | | CO3 | R | 1 |
| 7. | Name one challenge in edge caching related to user behavior. | | CO4 | R | 1 |
| 8. | Identify an attack overwhelming a network to disrupt communication. | | CO4 | R | 1 |
| 9. | State federated learning in the context of edge AI. | | CO5 | R | 1 |
| 10. | Name one key technology used in the Autonomous Internet of Vehicles (IoVs) for vehicle communication. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between Cloudlets and Micro Data Centers in Edge AI. | | CO1 | U | 3 |
| 12. | Explain the benefits of using DevOps practices in Edge AI software delivery. | | CO2 | U | 3 |
| 13. | List three general methods used to optimize AI models for edge devices. | | CO3 | R | 3 |
| 14. | Describe the contribution of Deep Q-Learning (DQL) to energy optimization in edge communication. | | CO4 | U | 3 |
| 15. | Explain the impact of coded shuffling on communication efficiency in distributed learning. | | CO5 | U | 3 |
| 16. | Describe the optimization of task offloading in IoVs enabled by Deep Reinforcement Learning (DRL). | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze privacy and security challenges in Edge AI deployments and propose mitigation strategies. | CO1 | An | 8 |
|  | b. | Explain the importance of resource allocation in Edge AI architectures. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the key features and advantages of Travis CI and Circle CI. | CO2 | An | 6 |
|  | b. | Compare Virtual Machines and Containers in Edge AI deployment, focusing on resource usage and isolation. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Evaluate early exit inference (EEoI) by describing mechanisms, benefits, challenges, and citing recent advancements such as BranchyNet and Edgent. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze joint optimization challenges in smart city edge networks and explain the way policy-gradient DRL methods enable orchestration of storage, networking, and computing resources. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the principles of coded computing in distributed edge training, including coded shuffling and straggler mitigation, with examples from wireless MapReduce. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain any two industrial applications of Edge Computing. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain joint edge optimization using AI techniques with suitable scenarios. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the End-Edge-Cloud architecture in real-time video analytics, detailing processing tasks at each layer, model updates, and system advantages. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the relation of AI and Edge Computing. |
| **CO2** | Illustrate the computing tools and technologies of Edge AI |
| **CO3** | Apply segmentation techniques to improve efficiency of AI models and develop secured distributed Edge applications. |
| **CO4** | Analyze AI for optimizing Edge applications. |
| **CO5** | Design the concepts of Mobile Edge AI. |
| **CO6** | Develop edge applications. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2005** | **Duration** | **3hrs** |
| **Course Title** | **AUTO ML** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Hyperparameter Tuning? | | CO1 | U | 1 |
| 2. | List any two key components of an AutoML system. | | CO1 | R | 1 |
| 3. | What is the primary function of AutoKeras? | | CO2 | R | 1 |
| 4. | Name the type of data format used for representing tabular data like in a spreadsheet. | | CO2 | R | 1 |
| 5. | Differentiate between a sequential pipeline and a graph-structured pipeline in AutoML. | | CO3 | U | 1 |
| 6. | What is the purpose of a custom AutoML block? | | CO3 | R | 1 |
| 7. | Why is Bayesian Optimization preferred over a grid search for hyperparameter tuning in complex models? | | CO4 | U | 1 |
| 8. | What is a surrogate function in the context of Bayesian Optimization? | | CO4 | R | 1 |
| 9. | How does data parallelism help in scaling AutoML? | | CO5 | U | 1 |
| 10. | Give an example of a real-world application where AutoML can be used for image classification. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the obstacles faced in the traditional machine learning process that AutoML aims to solve. | | CO1 | An | 3 |
| 12. | Illustrate the steps involved in configuring the tuning process for an automated image classification task. | | CO2 | U | 3 |
| 13. | Compare and contrast the process of tuning MLPs for structured data regression with tuning CNNs for image classification. | | CO3 | An | 3 |
| 14. | Explain the role of the acquisition function in a Bayesian optimization search method. | | CO4 | U | 3 |
| 15. | Analyze the challenges involved in handling large-scale text classification datasets in AutoML. | | CO5 | An | 3 |
| 16. | Summarize the key steps in the AutoML process for a supervised learning problem. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the "Three key components of AutoML" with a suitable diagram or example for each. | CO1 | U | 6 |
|  | b. | Discuss the significance of Feature Engineering and ML Algorithm Selection in the AutoML pipeline. |  | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the end-to-end process of building an AutoML solution for a structured data regression problem. | CO2 | A | 6 |
|  | b. | How does AutoML handle tasks with multiple inputs or outputs? Explain with a typical use case. |  | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Design a sequential AutoML pipeline for automated hyperparameter tuning, detailing each stage. | CO3 | C | 6 |
|  | b. | Explain the concept of designing custom AutoML blocks. What advantages do they offer over standard blocks |  | C | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the process of "Vectorizing the hyperparameters" and "Updating the surrogate function based on historical model evaluations" in a customized Bayesian optimization search. | CO4 | A | 6 |
|  | b. | Discuss the procedure for "Resuming the search process and recovering the search method". Why is this feature important in practical AutoML scenarios? |  | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | What is the difference between data parallelism and model parallelism? Explain how parallelization on multiple GPUs can accelerate the AutoML process. | CO5 | A | 6 |
|  | b. | Outline the general strategies for handling large datasets that do not fit into memory during an AutoML workflow. |  | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Create a taxonomy of AutoML, categorizing its various types and applications. | CO | C | 6 |
|  | b. | Design a high-level plan to apply AutoML for classifying topics of newsgroup posts, mentioning the key considerations for data preparation and model selection. |  | C | 6 |
|  |  |  |  |  |  |
| 23. | a. | Evaluate the impact of AutoML on the role of a data scientist. Discuss both the potential benefits and limitations. | CO | E | 6 |
|  | b. | Propose a novel application area (not mentioned in the syllabus) where AutoML could be implemented and describe the expected outcomes. |  | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Implement the search technique for a text classification problem. List the steps and key decisions involved from loading the dataset to model evaluation. | CO6 | A | 6 |
|  | b. | A Bayesian optimization search for tuning a GBDT model is taking too long. Suggest strategies to improve its efficiency without significantly compromising the quality of the results. |  | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the fundamentals of machine learning and auto ML techniques. |
| **CO2** | Develop end-to-end auto ML solutions. |
| **CO3** | Design auto ML pipelines. |
| **CO4** | Implement search process and recover search methods. |
| **CO5** | Apply data parallelism in auto ML for handling large-scale datasets. |
| **CO6** | Implement auto ML techniques in real-world application. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2006** | **Duration** | **3hrs** |
| **Course Title** | **DEVOPS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two drawbacks of monolithic architecture. | | CO1 | R | 1 |
| 2. | Identify the expanded form of IaC. | | CO1 | R | 1 |
| 3. | Define Ansible inventory file. | | CO2 | R | 1 |
| 4. | Define Terraform. | | CO2 | R | 1 |
| 5. | Identify the command that is used to initialize the new git repository. | | CO3 | U | 1 |
| 6. | Define package manager in DevOps workflow. | | CO3 | R | 1 |
| 7. | List any two benefits of kubernates in a DevOps workflow. | | CO4 | R | 1 |
| 8. | Identify the command used to push an image to Docker Hub. | | CO4 | U | 1 |
| 9. | Identify the purpose of collections in postman tool. | | CO5 | U | 1 |
| 10. | Define DevSecOps. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the steps in configuring terraform for azure. | | CO1 | U | 3 |
| 12. | Explain the steps in executing the packer. | | CO2 | U | 3 |
| 13. | Explain the functions of the following commands in git.   * Git status * Git clone <repo> * Git push | | CO3 | U | 3 |
| 14. | Apply Postman tool to generate a collection containing at least two API requests. | | CO4 | A | 3 |
| 15. | Identify the command used to run a Postman collection using Newman from the command line. | | CO5 | U | 3 |
| 16. | Explain the term “Shift Left” in the context of testing and security. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the history and the evolution of DevOps. | CO1 | U | 6 |
|  | b. | Analyze the Terraform lifecycle phases (init, plan, apply, destroy) and explain their role in automating IT infrastructure deployment and management | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the steps involved in constructing ansible inventory file for webserver and database servers. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Write a CI/CD Pipeline using Jenkins for E-Commerce Web Application | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Write the CLI commands for the following:   1. To install Newman globally using npm. 2. To run a Postman collection named StudentAPI.postman\_collection.json using Newman. 3. To list all npm packages installed globally on your system. | CO5 | A | 6 |
|  | b. | Explain the ansible inventory file with its yaml structure. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Write the Terraform commands for the following:   1. To initialize a new working directory containing Terraform configuration files. 2. To create an execution plan for the changes required to reach the desired state of the infrastructure. 3. To validate the syntax and configuration of your Terraform files before applying them. | CO3 | A | 6 |
|  | b. | Explain IaC and its best practices. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the steps in building and running a docker container. | CO4 | U | 6 |
|  | b. | Explain the major challenges in container orchestration. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Construct a Postman collection and integrate it into a CI/CD pipeline to automate testing for every build of the given scenario.  You are part of a development team building an e-commerce application. The backend exposes multiple APIs for user registration, product catalog, and order management. The QA team wants to automate API testing to ensure reliability before each deployment. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the DevSecOps and the integration of security throughout the software development lifecycle. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Implement DevOps principles |
| **CO2** | Implement setting up and managing CI/CD pipelines |
| **CO3** | Demonstrate the containerization and orchestration tools |
| **CO4** | Illustrate the automated infrastructure and configuration management. |
| **CO5** | Construct monitoring and logging solutions |
| **CO6** | Apply the security practices in DevOps. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2007** | **Duration** | **3hrs** |
| **Course Title** | **WEB APPLICATION SECURITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define software security in the context of web applications. | | CO1 | R | 1 |
| 2. | Identify the machine used for encrypting messages during World War II. | | CO1 | R | 1 |
| 3. | State the main objective of reconnaissance in web application security. | | CO2 | R | 1 |
| 4. | Name any one tool used for sub-domain enumeration. | | CO2 | R | 1 |
| 5. | List the function of an API key in web communication. | | CO3 | R | 1 |
| 6. | Name any one example of an injection attack. | | CO3 | R | 1 |
| 7. | Describe the purpose of OAuth2 in web applications. | | CO4 | U | 1 |
| 8. | Explain how rate limiting protects APIs from misuse. | | CO4 | U | 1 |
| 9. | State the abbreviation of OWASP. | | CO5 | R | 1 |
| 10. | Define ethical hacking. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the evolution of software security and how it shaped modern web application defense strategies. | | CO1 | U | 3 |
| 12. | Describe how reconnaissance helps in identifying vulnerabilities before launching attacks. | | CO2 | U | 3 |
| 13. | Illustrate how secure APIs prevent unauthorized data access with suitable example. | | CO3 | A | 3 |
| 14. | Analyze the significance of OAuth2 in protecting APIs from impersonation attacks. | | CO4 | An | 3 |
| 15. | Create a short plan outlining the steps involved in conducting a vulnerability assessment using Nikto or Burp Suite. | | CO5 | C | 3 |
| 16. | Evaluate how ethical hacking practices contribute to strengthening an organization’s web security posture. | | CO6 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the major historical milestones that led to the evolution of modern web application security. | CO1 | U | 6 |
|  | b. | Evaluate how early security incidents have influenced the current security models for web applications. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the various reconnaissance strategies used in mapping web applications. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain how secure API design prevents common attacks such as injection and spoofing. | CO3 | U | 8 |
|  | b. | Develop an approach to implement secure authentication mechanisms in RESTful APIs. | CO3 | C | 4 |
|  |  |  |  |  |  |
| 20. |  | Compare different API security controls such as rate limiting, access control, and encryption. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the scenario and answer: You are working as a **security tester** for a company that runs an **online shopping website**. The company wants you to check the website for any **security weaknesses** using either **Burp Suite** or **OpenVAS**.  **Question:** A)**Propose** a simple **penetration testing framework** using Burp Suite or OpenVAS. Your answer should include the **main steps** you would follow such as information gathering, scanning, finding vulnerabilities, and reporting results.  B) List any three common vulnerabilities that you might find in a web application. For each vulnerability, suggest one suitable countermeasure or fix. based on the scenario. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate how secure coding principles can reduce the attack surface of web applications. | CO1 | U | 6 |
|  | b. | Analyze how secure software design principles contribute to defense-in-depth strategies. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Analyze how sub-domain enumeration assists attackers and defenders during penetration testing. | CO2 | An | 6 |
|  | b. | Explain the impact of reconnaissance automation tools on web application security. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Formulate an ethical hacking methodology that aligns with organizational policies and legal frameworks. | CO6 | C | 6 |
|  | b. | Develop a comprehensive roadmap for continuous security improvement in modern web applications. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Synthesize the key historical milestones and current threats in web application security. |
| **CO2** | Implement advanced reconnaissance techniques to gather information and map web applications. |
| **CO3** | Develop secure web applications utilizing secure APIs. |
| **CO4** | Distinguish threats and appropriate security controls for APIs. |
| **CO5** | Design comprehensive strategies for vulnerability assessment and penetration testing. |
| **CO6** | Formulate ethical hacking techniques and tools to enhance security. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2009** | **Duration** | **3hrs** |
| **Course Title** | **SECURITY AND PRIVACY IN CYBER PHYSICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define a cyber-physical system. | | CO1 | U | 1 |
| 2. | Name one function of the perception layer in CPS. | | CO1 | R | 1 |
| 3. | Identify any one type of memory used in embedded CPS. | | CO2 | R | 1 |
| 4. | List two types of communication protocols used in CPS. | | CO2 | R | 1 |
| 5. | Explain the concept of residual in state estimation. | | CO3 | U | 1 |
| 6. | State the purpose of SDN in CPS security. | | CO3 | R | 1 |
| 7. | Describe the role of anonymization in big data CPS. | | CO4 | U | 1 |
| 8. | Define homomorphic encryption. | | CO4 | R | 1 |
| 9. | Explain the impact of POS malware on financial systems. | | CO5 | U | 1 |
| 10. | Describe one forensic tool used in CPS investigations. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the role of hybrid systems in CPS modeling. | | CO1 | An | 3 |
| 12. | Explain the difference between microcontroller and microprocessor in CPS. | | CO2 | U | 3 |
| 13. | Analyze the working of statistical methods to detect anomalies in CPS. | | CO3 | An | 3 |
| 14. | Illustrate the working of SDN to mitigate pilot contamination attacks. | | CO4 | U | 3 |
| 15. | Analyze the effectiveness of k-anonymity in privacy preservation. | | CO5 | An | 3 |
| 16. | Explain the need for forensic validation to improve CPS security. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Describe hybrid model with suitable example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Apply PID control to a smart grid voltage regulation scenario. | CO2 | A | 6 |
|  | b. | Analyze the working of synchronous and asynchronous models. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the memory and input/output architecture in CPS. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the working of physical and network layer communication protocols. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the need for transmitters in CPS communication. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the working of state estimation based attack detection. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the impact of POS device attacks and propose mitigation strategies. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the reliability of forensic investigation tools in CPS. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze various functionalities of Cyber Physical Systems (CPS). |
| **CO2** | Illustrate the basic components of CPS such as protocols and technologies. |
| **CO3** | Demonstrate the threat landscape in CPS. |
| **CO4** | Illustrate the various security features in cloud environments and embedded systems. |
| **CO5** | Analyze the security and privacy policies in Big Data CPS environments. |
| **CO6** | Assess the security functions of CPS. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24DC2010** | **Duration** | **3hrs** |
| **Course Title** | **CYBER SECURITY FOR INTERNET OF THINGS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the role of a secure element in IoT devices. | | CO1 | U | 1 |
| 2. | Identify the use of fault tree. | | CO1 | R | 1 |
| 3. | Identify one threat in smart home IoT systems. | | CO2 | R | 1 |
| 4. | List the components evaluated by the DREAD model. | | CO2 | R | 1 |
| 5. | Describe the function of a CAN bus in automotive IoT systems. | | CO3 | U | 1 |
| 6. | Define spoofing in the STRIDE framework. | | CO3 | R | 1 |
| 7. | Explain the significance of trust boundaries in threat modeling. | | CO4 | U | 1 |
| 8. | Define discrepancy report in V&V. | | CO4 | R | 1 |
| 9. | Identify a security risk of open debug ports. | | CO5 | U | 1 |
| 10. | Describe the role of TLS in IoT gateway communication. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the role of OEMs in securing IoT hardware. | | CO1 | An | 3 |
| 12. | Explain residual risk with an example. | | CO2 | U | 3 |
| 13. | Evaluate the impact of insecure firmware update processes. | | CO3 | An | 3 |
| 14. | Define asset in IoT. | | CO4 | U | 3 |
| 15. | Analyze secure configurations in RTOS-based IoT devices. | | CO5 | An | 3 |
| 16. | Explain certificate-based authentication in IoT gateways. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Describe the phases of IoT device lifecycle and associated security roles. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Apply threat modeling to a smart healthcare system using STRIDE. | CO2 | A | 6 |
|  | b. | Differentiate threat, risk and vulnerability. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the integration of security in the design phase of IoT development life cycle. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the working of application and transport layer protocols of IoT. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Justify secure protocol configurations in Bluetooth and ZigBee. | CO4 | E | 6 |
|  | b. | Describe the authentication credentials used in IoT. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain the use of OAuth 2.0 to enable a mobile app to securely access the user’s Google Drive data without exposing the user’s credentials. Describe the sequence of steps involved in this authorization process. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the role of cryptography in IoT. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the working of key management techniques in IoT. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Implement key concepts and principles of cyber security in IoT. |
| **CO2** | Analyze and evaluate security threats and vulnerabilities in IoT systems. |
| **CO3** | Demonstrate and implement security solutions for IoT devices and networks. |
| **CO4** | Apply cryptographic methods and protocols to secure IoT communications. |
| **CO5** | Design security frameworks and standards for IoT. |
| **CO6** | Solve security assessments for IoT environments. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25DC201** | **Duration** | **3hrs** |
| **Course Title** | **LINEAR ALGEBRA AND CALCULUS FOR DATA SCIENCE AND CYBER SECURITY ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | The covariance matrix in a Principal Component Analysis (PCA) is A=.*Calculate* the sum and product of the eigenvalues of A. | 1a | R | 1 |
| 2. | In anomaly detection, the quadratic form Q(x) =xᵀAx is used, where A is a symmetric matrix. *Determine* Q(x) for A=and x=. | 1d | R | 1 |
| 3. | *Define* the three factors of Eigen decomposition of a matrix A. | 2c | R | 2 |
| 4. | *List* two applications of singular value decomposition. | 2d | R | 2 |
| 5. | ***Determine*** the execution time T(n) for a program with three nested loops each runs n times, and each inner iteration takes 2 milliseconds and hence find T (2). | 3a | R | 3 |
| 6. | *Calculate* the gradient of the cost function C(x1​,x2​) =3x12​+4x22​, where x1 denotes the material cost and x2 denotes the laborhours. | 3e | U | 3 |
| 7. | A quality control engineer is analysing the time-to-failure for a batch of LED lights, and the raw data suggests the failure time is modelled by the Gamma function.*Determine* the final numerical result of this integral. | 4e | U | 4 |
| 8. | A company manufactures LED strips for smart lighting. The brightness along the strip varies with position according to the function B(x)=3+4sinx.*Compute* the total brightness along a section of the strip using a line integral. | 4a | U | 4 |
| 9. | *Identify* the order and degree of the differential equation( d2y/dx2)2-(dy/dx) +3=0 | 5a | R | 5 |
| 10. | A long-term trend in data shows a dominant consistent influence over time, leading to a sustained exponential behavior. *Compute* the solution of the differential equation that represents this in trend forecasting. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | In a machine learning optimization problem, the quadratic form is given in canonical form as q(y) = 2y₁² + 3y₂²+4y32. *Compute* the (i) matrix of q(y)(ii) eigen values (iii) rank (iv) index (v) signature (vi) nature of this quadratic form. | 1d | U | 1 |
| 12. | In image compression a 2X2 pixel block is represented by a matrix A =  *Determine* the singular values of A to reduce the storage. | 2d | U | 2 |
| 13. | *Calculate* divergence and curl of the vector field **F** (x, y, z) = F(3x,4y,5z). Also check whether **F** is solenoidal and irrotational. | 3e | A | 3 |
| 14. | In terrain modeling, a drone equipped with gray scale sensors scans a landscape path. The brightness from a surface like a road is given as: . This helps to determine the texture smoothness of scanned paths. *Compute* the total brightness recorded. | 4b | A | 4 |
| 15. | A company monitors the traffic on its website and observes that user visits fluctuate periodically throughout the day due to varying online activity. To model these periodic spikes in website traffic, the rate of change in the number of active users, y(t), over time t, is governed by the second-order differential equation:  . *Determine* the general solution and interpret the physical meaning of the solution in terms of website traffic behaviour. | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | A tiny website has three pages: A, B, and C. The link structure is as follows:  Page A links to pages B and C.  Page B links to pages A and C.  Page C links to pages A and B.  (i)*Construct* the link matrix L (ii) *Draw* the network graph and (iii) *Compute* the principal eigenvector to interpret the page importance. | 1b | A | 1 |
| **(OR)** | | | | |
| 17 | A data scientist is analysing 3 features from a dataset: Feature1(x1), Feature 2 (x2) and Feature 3(x3). The covariance matrix for these features is:  . *Calculate* the eigenvalues (importance scores) and eigenvectors (the new "combined" features) to identify the principal component that captures the maximum variance. | 1a | A | 1 |
|  |  |  |  |  |
| 18 | In a CPU task scheduler, the resource weights x1, x2, x3 for three processes P1, P2, P3 are determined by a system of linear equations. This system can be represented in the matrix form Ax=b. *Compute* the resource weights vector x by solving this system using LU decomposition, where A, x, and b are defined as:  A=.  Bottom of Form | 2a | A | 2 |
| **(OR)** | | | | |
| 19 | In an image-smoothing filter, the pixel intensity weights x1, x2, x3 must be determined from neighbourhood relationships. This creates a system of linear equations in the form Ax = b. *Compute* the weights vector x by solving this system using Cholesky decomposition, where A, x, and b are defined as:  A=. | 2b | A | 2 |
|  | | | | |
| 20 | *Determine* the values of x and y that maximize the contrast function  C (x, y) =x2+4y2 subject to the constraint x+y=10 in image processing using method of Lagrange multipliers. | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | (a)*Minimize* the runtime of the graphics-rendering pipeline, modeled by the function T(n)=2n2−8n+100, by finding the optimal number of worker threads, n.  (b) *Determine* the rate of change T′(n) and T′(2) for a script's execution time, which is modeled by the function T(n)=(2n+3)(3n+4), where T is the time in milliseconds and n is the input size in thousands of records, using product rule of differentiation and interpret its meaning. | 3b | A | 3 |
|  |  |  |  |  |
| 22 | (a)A linear LED strip’s brightness along its length is B(x)=x2cosx,  x (0, π). *Determine* the total reflected light intensity using integration by parts.  (b) Brightness decreases towards the edges of a camera sensor given as: B(x)=100(3-x)3, 0 < x< 2 mm. *Compute* the total brightness using integration by substitution. | 4c, d | A | 4 |
| **(OR)** | | | | |
| 23 | (a)A pixel on a digital display has the brightness function B(x,y)=10x+25y over the square region 0 ≤ x ≤ 3, 0 ≤ y ≤ 3.*Compute* the total surface brightness.  (b)The intensity inside a cube is I(x,y,z)=x+y+z, 0 ≤ x,y,z ≤ 2. *Compute* the total volume brightness. | 4f | A | 4 |
|  | | | | |
| **Compulsory Question:** | | | | |
| 24 | A local store is experiencing a drop in weekly sales because of new competition in the area. The change in sales over time is modelled by the following second-order differential equation: , with initial conditions y(0)=1000,**0,** where y(t) represents the weekly sales (in units), and t is the time in weeks.***Solve*** the differential equation and predict the sales after 3 weeks. | 5d | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25DC202** | **Duration** | **3hrs** |
| **Course Title** | **LOGIC BUILDING USING C** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | *Define* an algorithm with one simple example related to daily life (e.g., preparing tea). | 1a | R | 1 |
| 2. | *List* any two advantages of developing pseudocode before writing a program. | 1b | R | 1 |
| 3. | *Develop* a ‘C’ program using nested for loops to print the multiplication table from 1 to 10. | 2a | A | 2 |
| 4. | *Differentiate* between entry-controlled and exit-controlled loops in C with examples. | 2b | U | 2 |
| 5. | *Write* a C program that accepts five integers in an array and displays the largest and smallest numbers. | 3a | A | 3 |
| 6. | A librarian wants to help students find a specific book from a list of books arranged in alphabetical order. ***Identify* the most suitable searching technique** and **justify your answer** with a brief explanation. | 3b | U | 3 |
| 7. | *Write* a C program to add two numbers using an inline function. | 4a | A | 4 |
| 8. | *Define* recursion and write its syntax using a simple factorial example. | 4b | U | 4 |
| 9. | *State* the importance of the dereference (\*) operator when using pointers. | 5a | R | 5 |
| 10. | *Give* an example for structure declaration and initialization in C. | 5b | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | *Apply* the steps of program development to write an algorithm and flowchart for finding the largest of three numbers. | 1a | A | 1 |
| 12. | *Apply*conditional statements to write a C program that determines whether an entered number is positive, negative, or zero. | 2a | A | 2 |
| 13. | *Develop* a C program that reads 10 student marks into an array and computes the total and average. | 3a | A | 3 |
| 14. | *Write* a C program that uses a recursive function to calculate the factorial of a given number. | 4b | A | 4 |
| 15. | ***Develop* a C program using pointers and dynamic memory allocation** to input N sales values, calculate the **total and average sales**, and display the results. | 5a | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | ***Apply* the steps of program development** to show the way a problem statement can be transformed into a working C program. | 1c | A | 1 |
| **(OR)** | | | | |
| 17 | *Use* debugging techniques list the **syntax** and **semantic errors** in the following C program and rewrite the correct code.  #include <stdio.h>  int main()  {  int n, i, sum;  float average;  printf("Enter the number of students: ");  scanf("%d", n);  int marks[n];  for(i = 1; i <= n; i++);  {  printf("Enter mark of student %d: ", i);  scanf("%d", &marks[i])  sum = sum + marks[i]  }  average = sum / n;  printf("Average mark = %f", average) // Error: Missing semicolon  return 0  } | 1f | A | 1 |
| 18 | ***Develop* a C program** to calculate the **gross salary** of multiple employees in an organization. The program should:   1. Accept the **basic salary** of each employee. 2. Compute the following for each employee:    1. **HRA = 20% of Basic Salary**    2. **DA = 40% of Basic Salary**    3. **PF = 12% of Basic Salary**    4. **Gross Salary = Basic + HRA + DA – PF** 3. Display the **gross salary** of each employee along with their **employee number.** | 2b | A | 2 |
| **(OR)** | | | | |
| 19 | *Explain* the use of nested control structures in C and discuss their role in handling multi-level decision-making problems effectively. | 2g | A | 2 |
| 20 | ***Develop* a C program** that stores the following integers in an array [12, 45, 23, 67, 34, 89, 10, 56, 78, 25] and implements the **Linear Search** technique to locate a specific number entered by the user. Display whether the number is found and, if so show its **index position** in the array. | 3b | A | 3 |
| **(OR)** | | | | |
| 21 | ***Explain* the concept and advantages of the Binary Search algorithm** with suitable example. | 3d | U | 3 |
| 22 | ***Explain* the different parameter passing mechanisms in C,** namely **Call by Value** and **Call by Reference** with suitable examples. | 4b | A | 4 |
| **(OR)** | | | | |
| 23 | A grocery store wants to analyze the prices of its items to understand pricing trends.  ***Develop* a C program** that passes an array of item prices to a function named analyzePrices() which performs the following operations:   1. Calculates the total and average price of all items. 2. Displays all prices greater than the average price.   The main function should:   * Accept the number of items and their prices from the user. * Pass the array to the analyzePrices() function for processing. | 4d | An | 4 |
| **Compulsory Question:** | | | | |
| 24 | In an online bookstore application, the number of books purchased by each customer varies.  *Explain*the use of dynamic memory allocation techniques such asmalloc()**,** calloc()**,** realloc()**,** andfree()to efficiently manage memory for storing five book prices during runtime. | 5c | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25DC203** | **Duration** | **3hrs** |
| **Course Title** | **COMPUTER ORGANIZATION AND ARCHITECTURE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | *Define* the three types of buses in CPU and their functionalities. | 1a | R | 1 |
| 2. | *Describe* the two types of interrupts in a CPU. | 1d | U | 1 |
| 3. | *Define* NAND gate and NOR gate. | 2b | R | 2 |
| 4. | *Describe* any two components of a Control unit. | 2c | U | 2 |
| 5. | *Describe* the two main types of SRAM. | 3a | U | 3 |
| 6. | *List* the types of cache mapping techniques in CPU. | 3d | R | 3 |
| 7. | *Describe* the purpose of LED interfacing. | 4b | U | 4 |
| 8. | *Compute* the digital output of an 8-bit ADC with Vin = 3V, Vref = 5V. | 4d | U | 4 |
| 9. | *List* any four differences between CPU and GPU. | 5b | R | 5 |
| 10. | *Define* FPGA and how it differs from CPU or GPU. | 5c | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
|  | | | | |
| 11. | *Interpret* the use of Implied Addressing mode, Register Addressing mode and Register Indirect Addressing mode, with an example for each. | 1c | A | 1 |
| 12. | *Compute* the two’s complement for the following decimal values:  a. –32  b. –60  c. –131  d. –510  e. –612 | 2a | A | 2 |
| 13. | *Explain* the types of memory allocation in programming, their advantages and disadvantages, and apply each type with a suitable example. | 3c | A | 3 |
| 14. | *Analyze* the row and column binary inputs to identify the pressed key on the 4x4 keypad matrix shown below, with step-by-step explanation.   1. D3 – D0 = 1011 for the row, D3 – D0 = 1101 for the column 2. D3 – D0 = 1110 for the row, D3 – D0 = 1101 for the column 3. D3 – D0 = 0111 for the row, D3 – D0 = 1011 for the column | 4c | An | 4 |
| 15. | *Analyze* the need for a GPU in modern computing systems with an explanation of any four key differences between a GPU and a CPU. | 5b | An | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | *Explain* the features of RISC and CISC architectures, and recommend the suitable architecture for modern processors. | 1e | A | 1 |
| **(OR)** | | | | |
| 17 | *Explain* the instruction cycle and the function of each stage. | 1a | A | 1 |
|  |  |  |  |  |
| 18 | *Illustrate* the micro-operations for Immediate Addressing Mode with an example. | 2c | A | 2 |
| **(OR)** | | | | |
| 19 | *Explain* the micro-programmed control unit and the role of its components in executing instructions. | 2d | A | 2 |
|  |  |  |  |  |
| 20 | ***Apply*** the memory hierarchy concept to justify cache’s higher speed than main memory. | 3a | An | 3 |
| **(OR)** | | | | |
| 21 | *Explain* the differences between Cache and RAM and relate them to system performance | 3d | A | 3 |
|  |  |  |  |  |
| 22 | *Illustrate* the architecture of ADC 0808/0809 and its functionality to convert analog signals into digital form. | 4d | A | 4 |
| **(OR)** | | | | |
| 23 | *Explain* the NPU and relate its features in comparison with a TPU. | 5e | A | 5 |
| **Compulsory Question:** | | | | |
| 24 | *Evaluate* the role of DMA in enhancing overall system performance compared to CPU-controlled data transfer methods, and elaborate on its advantages, disadvantages, and real-world applications. | 3e | E | 3 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25DC204** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Differentiate between Artificial Intelligence and Natural Intelligence. | 1d | U | 1 |
| 2. | List the three components of expert systems. | 1e | R | 1 |
| 3. | Define heuristic function. | 2i | R | 2 |
| 4. | Describe generic searching. | 2e | U | 2 |
| 5. | Explain the properties of good knowledge representation system. | 3b | R | 3 |
| 6. | Use propositional logic to represent the following statements:  All Pompeians were Roman.  All Romans were either loyal to Caesar or hated him. | 3e | A | 3 |
| 7. | Define neural network. | 4b | R | 4 |
| 8. | Describe the components of learning problem. | 4f | U | 4 |
| 9. | List the issues in designing AI agent. | 5a | R | 5 |
| 10. | Explain the steps involved in designing tutor. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Explain expert systems and its applications. | 1e, 1f | A | 1 |
| 12. | Determine the DFS and BFS ordering for the following tree: | 2g 2h | A | 2 |
| 13. | Describe the different approaches to knowledge representation. | 3b | A | 3 |
| 14. | Illustrate the issues in learning. | 4a | An | 4 |
| 15. | Develop an AI agent to diagnose cancer. | 5a | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Describe the agents situated in different environments. | 1d | U | 1 |
| **(OR)** | | | | |
| 17 | Explain different types of agents. | 1c | U | 1 |
|  |  |  |  |  |
| 18 | Explain graph searching. | 2d | U | 2 |
| **(OR)** | | | | |
| 19 | Determine the path to reach from Start node ‘A’ to goal node ‘G using best first search technique. | 2i | An | 2 |
|  |  |  |  |  |
| 20 | Use well-formed formula (wff) for the following facts:  1. John likes all kinds of food.  2. Apples are food.  3. Chicken is food  4. Anything anyone eats and is not killed by is food.  5. Bill eats peanuts and is still alive.  6. Sue eats everything Bill eats.  a) Convert these facts to wff in predicate logic.  b) Using backward chaining prove that “John likes peanuts”. | 3e | A | 3 |
| **(OR)** | | | | |
| 21 | Explain the concept of resolution with one example. | 3f | U | 3 |
|  |  |  |  |  |
| 22 | Explain reinforcement learning. | 4h | U | 4 |
| **(OR)** | | | | |
| 23 | Explain different types of planning. | 4f | U | 4 |
| **Compulsory Question:** | | | | |
| 24 | Develop a smart home AI agent. | 5d | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25DC205** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL SYSTEM DESIGN FOR DATA SCIENCE AND CYBER SECURITY ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | UseDe Morgan's Laws to simplify the following Boolean expression F= (X+Y′)′. | 1b | A | 1 |
| 2. | Recall and draw the logic symbols of the **XOR and XNOR gates.** | 1d | R | 1 |
| 3. | Identify any two differences between encoder and decoder. | 2d | A | 2 |
| 4. | Interpretthe meaning of the output A < B = 1 in a magnitude comparator. | 2e | U | 2 |
| 5. | Listthe different types of shift registers. | 3b | R | 3 |
| 6. | Explain the truth table of D flip flop. | 3a | U | 3 |
| 7. | Explainthe primary function of Random Access Memory (RAM) in a computer system in about 30 words. | 4b | U | 4 |
| 8. | Explain volatile memory in about 30 words with an example. | 4a | U | 4 |
| 9. | Recallany two examples of AI accelerator chips. | 5e | R | 5 |
| 10. | Explaina module in Verilog in about 30 words. | 5a | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | In the banking industry, ATMs use multi-factor authentication for enhanced security. To grant access, the embedded security chip verifies:  C = Correct Card Inserted  P = Correct PIN Entered  F = Fingerprint Match  The ATM grants Access (A = 1) if:  The card and PIN are valid, OR  The card and fingerprint match.  Identifythe Boolean expression, truth table and the minimised logic using kmap in order to reduce the number of gates to avoid hardware complexity. | 1a | A | 1 |
| 12. | Illustratethe entry of the 4-bit data 1010 into a 4-bit register, and the serial shifting of the 4 bits out of the register. | 2b | An | 2 |
| 13. | Distinguish between SR and JK flip flop with at least four points. | 3a | An | 3 |
| 14. | Distinguishbetween Random Access Memory(RAM) and Read Only Memory(ROM) with at least four points. | 4a | An | 4 |
| 15. | Explain the operation of each component in a basic FPGA architecture. | 5a | An | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | An automated room lighting system has three sensors/inputs:  **M** = 1 when motion is detected in the room, otherwise 0.  **L** = 1 when ambient light is low (i.e., it is dark), otherwise 0.  **O** = 1 when the manual override switch is ON, otherwise 0.  The lamp (output **Y**) should turn ON when **motion is detected** and**either ambient light is low or the manual override is ON.** In other words: the lamp runs when M = 1 **and** (L = 1 OR O = 1).  Identify the Boolean expression, Truth table, SOPs using K-map and the logic circuit **required.** | 1e | A | 1 |
| **(OR)** | | | | |
| 17 | An automated conveyor belt should run only under safe and authorized conditions. The system has three inputs:   1. **E** — Emergency-stop status (1 = emergency stop not pressed / safe), 2. **P** — Primary power OK (1 = power available), 3. **M** — Manual override (1 = manual override enabled by supervisor).   The conveyor should run **(Y = 1)** when either:   1. Both emergency-stop is safe and primary power is OK **(E AND P); OR** 2. Manual override is enabled and emergency-stop is safe **(M AND E).**   Identifythe Boolean expression, Truth table, SOPs using K-map and the minimum number of logic gates **required.** | 1e | A | 1 |
|  |  |  |  |  |
| 18 | Explain4x1 multiplexer based its on block diagram and truth table. | 2c | U | 2 |
| **(OR)** | | | | |
| 19 | Explain the Full Adder circuit. Include its truth table, logic circuit diagram, and the derivation of its outputs – Sum and Carry. | 2a | U | 2 |
|  |  |  |  |  |
| 20 | Illustrate the function of a BCD adder using its truth table, K-map simplification, and logic diagram. | 3d | U | 3 |
| **(OR)** | | | | |
| 21 | Illustrate the function of a 4-bit asynchronous counter using a logic diagram. | 3f | U | 3 |
|  |  |  |  |  |
| 22 | Evaluatea combinational logic circuit for the Boolean function F = A + B using Verilog HDL. Include the design code, testbench code, truth table, and the expected output. | 4e | E | 4 |
| **(OR)** | | | | |
| 23 | Evaluate a Programmable Logic Array (PLA) implementation for the following Boolean functions:  F0 = A + B' C'  F1 = A C' + A B  F2 = B' C' + A B  F3 = B' C + A | 4c | E | 4 |
| **Compulsory Question:** | | | | |
| 24 | Design a 4×4 Random Access Memory (RAM) using Verilog HDL. Include the design code, test bench code and the expected output for all input combinations. | 5c | A | 5 |