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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18RO2010** | **Duration** | **3hrs** |
| **Course Title** | **PROGRAMMABLE LOGIC CONTROLLERS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the layer of automation pyramid where sensors are involved. | | CO1 | U | 1 |
| 2. | Define scan cycle | | CO1 | R | 1 |
| 3. | Define the logical value of a normally closed contact. | | CO2 | R | 1 |
| 4. | Identify the module where the Thermocouple, RTD, and limit switches can be connected. | | CO2 | R | 1 |
| 5. | Identify the location used to store the program stored in PLC | | CO3 | U | 1 |
| 6. | Name the timer that is used to turn on a light after a delay of 10 seconds. | | CO3 | R | 1 |
| 7. | State the bit functions in PLC. | | CO4 | U | 1 |
| 8. | Identify the function that forces the outputs off for the specified rungs | | CO4 | R | 1 |
| 9. | List a few PLC’s that has text display intergerated. | | CO5 | U | 1 |
| 10. | State different Industrial protocols that are used for industrial automation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare relay logic and PLC | | CO1 | A | 3 |
| 12. | State the role of Isolators in PLC | | CO2 | U | 3 |
| 13. | Write the use of Interlock in PLC programming. Give example | | CO3 | U | 3 |
| 14. | Draw a ladder diagram for the following condition:  A machine, M, is to be turned on either when count A goes up to 11 or when count B goes up to 16. One stop button resets the entire process. | | CO4 | A | 3 |
| 15. | Write the uses of HMI in PLC-based automation systems | | CO5 | A | 3 |
| 16. | List the maintenance procedures used for PLC | | 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. | Explain the history and development of industrial automation and its evolution over time. | CO1 | U | 6 |
|  | b. | List the key control elements used in industrial automation and discuss their roles in effective production | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the architecture of a PLC. Discuss its components such as CPU, memory, power supply, I/O modules, and how they interact during the PLC scan cycle | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Develop a ladder diagram for the following industrial problem.  A conveyor is run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. For the conveyor a sorting system is added. Gages have been attached that indicate good or bad. If the part is good, it continues on. If the part is bad, we do not want to delay for 2 seconds, but instead actuate a pneumatic cylinder | CO3 | A | 8 |
|  | b. | Draw a ladder program to operate a light according to the following sequence:  • A momentary pushbutton is pressed to start the sequence.  • The light is switched on and remains on for 2 s.  • The light is then switched off and remains off for 2 s.  • A counter is incremented by 1 after this sequence.  • The sequence then repeats for a total of 4 counts.  • After the fourth count, the sequence will stop and the counter will be reset to zero. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Explain the operation and applications of arithmetic and comparison. | CO4 | U | 8 |
|  | b. | Illustrate the operation of SKIP instruction in PLC programming | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. |  | Discuss the role of Human Machine Interface in modern industrial automation systems and elaborate on the types of HMI devices. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | List the types of timers available in PLC and illustrate the same with examples. | CO3 | U | 8 |
|  | b. | Explain the working of MCR function with a relevant example. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Draw a ladder diagram for the following scenario:     * There are 3 groups participating in the quiz game: pupils, high school students, and professors. If they want to get the chance of answering the question from the host, they must press the answer button on their table first. Other groups’ pressing will be invalid if any group gets the chance successfully. * There are 2 answer buttons for the pupil group and professor group and 1 answer button for the high school student group. In order to give preferential treatment to the pupil group, Y0 will be ON if any one of X0 or X1 is pressed. However, in order to limit the professor group, Y2 will be ON when X3 and X4 are pressed at the same time. For the high school student group, Y1 will be ON when X2 is pressed. * If the host presses X5 (Reset button), Y0, Y1, and Y2 will be OFF. | CO4 | A | 8 |
|  | b. | Explain the operation of a Cascade Counter. | CO3 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the concept of Ethernet and its significance in modern industrial automation systems. Discuss its key features and advantages over traditional fieldbus systems. | CO6 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify and understand the automation concepts for Industries. |
| **CO2** | Apply PLC architecture knowledge to select PLC for specific problems. |
| **CO3** | Use PLC Ladder diagram for simple applications |
| **CO4** | Design real time application using PLC. |
| **CO5** | Create prototype for the real time application Using PLC, with HMI |
| **CO6** | Recognize the faults and identify the protocol to be used for the applications |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **18RO2011** | **Duration** | **3hrs** |
| **Course Title** | **AUTOMATION SYSTEM DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | **Name the phenomenon that ensures maximum utility and minimum wastage in a process.** | | CO1 | U | 1 |
| 2. | **Indicate the process of model solving that is performed using a computer.** | | CO1 | R | 1 |
| 3. | **Mention any two mechanical components used for linear motion in motion control systems.** | | CO2 | R | 1 |
| 4. | **List two examples of motion control applications.** | | CO2 | R | 1 |
| 5. | **Identify the device that enables linear motion using rolling elements.** | | CO3 | U | 1 |
| 6. | **Express the formula relating friction, loads, and frictional resistance.** | | CO3 | R | 1 |
| 7. | **Mention the full form of NIOSH.** | | CO4 | U | 1 |
| 8. | **Sketch a basic diagram of a dolly.** | | CO4 | R | 1 |
| 9. | **Name the type of conveyor that is suitable for a wide range of bulk materials.** | | CO5 | U | 1 |
| 10. | **Name the equipment used to remove foreign steel objects from belt-conveyed materials.** | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Elaborate on the multidisciplinary nature and applications of Mechatronics. | | CO1 | U | 3 |
| 12. | Illustrate the functional role of any three mechanical components commonly employed in motion control systems. | | CO2 | R | 3 |
| 13. | Interpret the phenomenon of fatigue flaking and discuss its implications on material performance. | | CO3 | An | 3 |
| 14. | Explain the space utilization principle in material handling and assess its impact on system efficiency. | | CO4 | U | 3 |
| 15. | Develop a concise overview highlighting the purpose, design, and applications of a plow. | | CO5 | A | 3 |
| 16. | Evaluate the economics involved in automation system design, emphasizing cost benefit considerations and long-term value. | | CO6 | An | 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. | Investigate and explain the critical sensing parameters involved in automated manufacturing processes. | CO1 | U | 5 |
|  | b. | Critically examine the key elements that constitute a mechatronic system for Industrial Automation with a neat block diagram. | CO1 | An | 7 |
|  |  |  |  |  |  |
| 18. |  | Outline the systematic procedure and essential steps required to compute motor load for selecting an appropriate motor. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Examine the core principles behind selecting linear guideways, and illustrate the complete selection procedure with clarity. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the concept, working, and industrial applications of Automated Guided Vehicles (AGVs). | CO4 | A | 6 |
|  | b. | Demonstrate the operational mechanisms of any two types of conveyors, supporting your explanation with relevant diagrams. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | With a neat sketch, explain the construction and function of the Pinion-swivel arrangement at the foot of a belt conveyor. | CO5 | R | 6 |
|  | b. | Discuss comprehensively the construction and operational details of belt trippers and belt cleaners, complemented by necessary diagrams. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Write brief notes outlining the different types of counterbalanced lift trucks. | CO4 | U | 6 |
|  | b. | Describe the working principle of Automated Storage and Retrieval Systems (ASRS) with suitable diagrams. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Describe the design and operation of suspended idlers, belt cleaners, and the essential safety mechanisms implemented at pulleys. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the integration process of a machine-tending robot with a CNC machine, highlighting the key elements with appropriate diagrams. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Specify the automation elements and requirements. |
| **CO2** | Select the appropriate precision motion components based on the application. |
| **CO3** | Analyze the motion control with more precise arrangements |
| **CO4** | Describe the basic design considerations of material handling equipment. |
| **CO5** | Design and select a belt conveyor for real world applications. |
| **CO6** | Analyze the integrating automation components |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **18RO2013** | **Duration** | **3hrs** |
| **Course Title** | **TOTALLY INTEGRATED AUTOMATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the HMIs which are dependent on internet connectivity. | | CO1 | A | 1 |
| 2. | State the industrialization version used for cyber security, internet of things and networks. | | CO1 | R | 1 |
| 3. | Define tag. | | CO2 | R | 1 |
| 4. | List various alarm logging used in SCADA | | CO2 | R | 1 |
| 5. | Write the function of Dynamic Data Exchange (DDE) protocol | | CO3 | U | 1 |
| 6. | List out the broad types of communication protocols | | CO3 | U | 1 |
| 7. | Give any one type of communication protocol used for DCS. | | CO4 | U | 1 |
| 8. | Define Local Control Unit (LCU) | | CO4 | R | 1 |
| 9. | Identify the types of control configuration of operator interface. | | CO5 | U | 1 |
| 10. | State any two electrical issues that are to be considered while selecting the electrical power in Industry | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the features and advantage of Industrial Automation. | | CO1 | U | 3 |
| 12. | List out the functionalities of WinCC. | | CO2 | U | 3 |
| 13. | Write down the features of OPC. | | CO3 | U | 3 |
| 14. | Compare DCS and SCADA. | | CO4 | An | 3 |
| 15. | List the levels of operator displays used in DCS. | | CO5 | U | 3 |
| 16. | Draw different symbols used in a process sequence chart. | | 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. |  | Draw the functional diagram of Totally Integrated Automation (TIA). Explain the functions of each component in the TIA. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the functions, features, advantages, limitations, and applications of Programmable Automation Controller. Also compare PLC with PAC. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the software architecture of SCADA system with relevant block diagram. Write the advantages, limitations and applications of SCADA systems. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the procedure to integrate VB scripts in SCADA screen with suitable example. | CO2 | A | 6 |
|  | b. | List the different Tag logging used in SCADA. Explain each with suitable example. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Elaborate the step-by-step procedure for interfacing SCADA system with Drives. | CO3 | A | 6 |
|  | b. | Explain the procedure used to implement recipe management in SCADA system. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Describe the major components of DCS with relevant block diagrams. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the type of engineering interfaces used in DCS. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Interpret the design criteria and process sequencing in Cement production plant layout with suitable diagram. | CO6 | A | 6 |
|  | b. | Examine the factors involved in selecting the best cable for Automation Industries. | CO6 | A | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Outline the selection, and application of various TIA control elements |
| **CO2** | Discuss the configuration of SCADA functionalities with Tags, Screens, and Trends |
| **CO3** | Compare various communication protocols for automation system |
| **CO4** | Identify and differentiate various sub systems of DCS |
| **CO5** | Describe various functions of Interfaces in DCS |
| **CO6** | Analyze and design an appropriate system for the industrial applications |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **18RO2015** | **Duration** | **3hrs** |
| **Course Title** | **FIELD AND SERVICE ROBOTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define autonomous mobile robot. | | CO1 | R | 1 |
| 2. | List the types of locomotion in service robots. | | CO1 | R | 1 |
| 3. | Identify the degrees of steerability in a robot. | | CO2 | U | 1 |
| 4. | Recall the concept of robot workspace. | | CO2 | R | 1 |
| 5. | List the sources of noise in localization. | | CO3 | U | 1 |
| 6. | State the significance of topological maps in mobile robotics. | | CO3 | U | 1 |
| 7. | Define metric maps. | | CO4 | R | 1 |
| 8. | List the advantages of grid-based mapping in robots. | | CO4 | R | 1 |
| 9. | Identify potential field path planning. | | CO5 | U | 1 |
| 10. | Define humanoid robots. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare wheeled and legged locomotion. | | CO1 | U | 3 |
| 12. | Write the importance of degrees of mobility in a robot. | | CO2 | U | 3 |
| 13. | List the localization algorithm used in autonomous robot. | | CO3 | R | 3 |
| 14. | Differentiate topological and hybrid maps. | | CO4 | U | 3 |
| 15. | Write the significance of roadmap path planning. | | CO5 | U | 3 |
| 16. | Explain the role of speech generation in robotics. | | 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 classification of service robot based on their applications. | CO1 | A | 6 |
|  | b. | Specify an overview of the historical development of field and service robotics. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Describe the different configurations used in legged and wheeled locomotion in robotics. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the role of maneuverability in robot design. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the Kalman filter algorithm with a suitable example. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Differentiate localization-based navigation and programmed solutions. | CO3 | U | 6 |
|  | b. | Describe in detail on probabilistic map based localization. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the process of SLAM in a household robot for efficient navigation and cleaning. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the path planning techniques in an industrial robot. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the features and functions of robots in Healthcare automation. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the applications and current trend in field and service robot |
| **CO2** | Explain about the kinematic modeling of mobile robots |
| **CO3** | Identify, formulate and solve algorithm related to localization, obstacle avoidance, and mapping |
| **CO4** | Apply and program robot for reactive concepts for robot interaction with human, between machines and among robots |
| **CO5** | Analyze the concepts of balancing legged robots and interaction interface concepts for humanoid robot |
| **CO6** | Implement path planning algorithms inside a field/service robot for navigation |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **19RO2012** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL INTELLIGENCE IN ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the first computer program to defeat the world champion in a chess match. | | CO1 | R | 1 |
| 2. | Identify the full form of PEAS in task environment specification. | | CO1 | U | 1 |
| 3. | Write the parameters to define alpha-beta pruning. | | CO2 | A | 1 |
| 4. | List the components that are used to define a problem. | | CO2 | R | 1 |
| 5. | Enumerate the conditions of partial-order plan for the shoes and socks problem. | | CO3 | R | 1 |
| 6. | Interpret the admissible heuristic estimate for state-space search. | | CO3 | U | 1 |
| 7. | Give an example for the process of lemmatization in language processing. | | CO4 | U | 1 |
| 8. | Indicate the key characteristics of supervised learning. | | CO4 | U | 1 |
| 9. | Define the posterior probability of an uncertain event. | | CO5 | R | 1 |
| 10. | State robotic perception in real-world scenarios. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Classify the types of agents based on their design. | | CO1 | U | 3 |
| 12. | Describe the terms and connective symbols with their meanings used in propositional logic-based knowledge representation. | | CO2 | U | 3 |
| 13. | Examine the total order planning in multi-goal scenarios. | | CO3 | A | 3 |
| 14. | Differentiate semi-supervised learning from unsupervised learning. | | CO4 | U | 3 |
| 15. | Interpret the causes of uncertainty by an agent to occur in the real world. | | CO5 | A | 3 |
| 16. | Summarize the ethics of artificial intelligence in robotics. | | 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 state of the art of Artificial Intelligence in robotics. | CO1 | U | 8 |
|  | b. | Describe the elements of learning-based agent with necessary block diagram. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain the AO\* algorithm used from problem reduction with suitable state space representation. | CO2 | An | 6 |
|  | b. | Solve the following cryptarithmetic problem.  SEND  + MORE  MONEY | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the progression and regression state space search planning algorithm for an AI system designed for cargo loading and unloading operations. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Apply Bayes rule to predict the flavor of the next piece of candy using statistical learning method. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the statistical Hidden Markov model with suitable examples. | CO5 | U | 9 |
|  | b. | Enumerate the applications of Hidden Markov Model in real-time scenario. | CO5 | R | 3 |
|  |  |  |  |  |  |
| 22. | a. | Summarize the human-centered and rational approaches applied in artificial intelligence. | CO1 | U | 6 |
|  | b. | Apply the A\* search strategy to move from the initial state to the final state in an 8-puzzle problem. Find the most cost-effective path to reach the final state. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Develop a gaming environment scenario using reinforcement algorithm for the process of decision-making. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the features of simultaneous localization and mapping used in robotic navigation. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Identify problems that are amenable to solution by AI methods. |
| **CO2** | Identify appropriate AI methods to solve a given problem. |
| **CO3** | Formalize a given problem in the language/framework of different AI methods. |
| **CO4** | Summarize the learning methods adopted in AI. |
| **CO5** | Design and perform an empirical evaluation of different algorithms on a problem formalization. |
| **CO6** | Illustrate the applications of AI in Robotic Applications. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20RO1004** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO ROBOTICS AND AUTOMATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Specify the degree of freedom of the robot shown in Fig.1.  2 DOF Serial Flexible Link - Quanser  Fig.1. | | CO1 | U | 1 |
| 2. | Name the first Industrial robot that was designed by Engelberger and Devol. | | CO1 | R | 1 |
| 3. | List any two types of range sensors used in robots. | | CO2 | R | 1 |
| 4. | Identify a suitable gripper for handling fragile glassware. | | CO2 | U | 1 |
| 5. | Write the general form of homogeneous transformation matrix. | | CO3 | U | 1 |
| 6. | List two capabilities and limitations of lead through programming technique. | | CO3 | U | 1 |
| 7. | Interpret the role of robots in the economic development of manufacturing industries. | | CO4 | U | 1 |
| 8. | Specify the desirable features of a welding robot. | | CO4 | U | 1 |
| 9. | Expand SCADA. | | CO5 | R | 1 |
| 10. | Name one technology used in building automation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A Cartesian Coordinate Robot has a prismatic joint with a total range of 10 inches. The robot’s control memory has a 12-bit storage capacity. Determine the control resolution of the joint. | | CO1 | A | 3 |
| 12. | Differentiate proprioceptive and exteroceptive sensing in a robot. | | CO2 | U | 3 |
| 13. | A position vector P = 2i + 2j + 4k is rotated by 90 degrees about the x axis of the reference frame. Determine the resultant position of the vector. | | CO3 | A | 3 |
| 14. | Specify the desirable characteristics of robots used in assembly applications. | | CO4 | U | 3 |
| 15. | Illustrate with a neat diagram, the characteristics of the three types of automation. | | CO5 | U | 3 |
| 16. | Interpret the role of AI in Robotics and Automation applications. | | 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. | Compare the work volume of 3 DoF manipulator with the following joint configuration.   1. LLL 2. RLL 3. RRL 4. RRR | CO1 | A | 6 |
|  | b. | Explain with suitable illustration how the Robots are specified. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare Internal and External gripping mechanisms with relevant examples and diagrams. | CO2 | A | 6 |
|  | b. | Interpret the role of proximity sensing in robotic applications and describe any one proximity sensor in detail. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Derive the forward and inverse kinematic equations of a 2 link RR Manipulator. | CO3 | U | 6 |
|  | b. | Compute the Cartesian coordinates for the end of the arm, given that the length of joints L1 = 8 in, L2= 10 in, angles θ1 = 30 degrees and θ2 = 60 degrees | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Classify mobile robots with relevant examples. | CO4 | U | 6 |
|  | b. | Illustrate the see-think-act cycle of an autonomous mobile robot with necessary diagrams and explanations. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Compare Open loop and Closed loop Control systems with relevant examples and diagrams. | CO5 | U | 6 |
|  | b. | Sketch the functional block diagram of a PLC and describe the working. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Specify the parameters that affect the precision of movement of a robot with relevant examples and diagrams. | CO1 | U | 6 |
|  | b. | Compare Joint Level, Object Level and Task Level Programming Techniques of a robot with relevant examples | CO3 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Specify the desirable features of a welding robot highlighting the merits and demerits of robot welding over manual welding. | CO4 | A | 6 |
|  | b. | Interpret the role of robots in healthcare and describe any one application with relevant example. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Sketch the model of a smart home highlighting the technological features incorporated in it. | CO6 | A | 6 |
|  | b. | Evaluate the impact of robots in the technology of the future with suitable case study. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the evolution of robots and their classification |
| **CO2** | Analyze the applications of sensors and actuators in robotics. |
| **CO3** | Describe the kinematics and dynamic behavior of robots and its programming. |
| **CO4** | Appraise the emerging technologies in the field of robotics |
| **CO5** | Compare different concepts of automation |
| **CO6** | Apply knowledge of automation in various fields |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20RO2001** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL ELECTRONICS AND MICROPROCESSORS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the basic logic gates used in digital circuits. | | CO1 | R | 1 |
| 2. | Convert binary to decimal (1011.01)2 | | CO1 | U | 1 |
| 3. | Identify a combinational circuit that accepts n input and gives 2n output. | | CO2 | R | 1 |
| 4. | Draw the gate level circuit for the expression y=AB using NOR gate. | | CO2 | U | 1 |
| 5. | List common applications of flip-flops in digital systems. | | CO3 | R | 1 |
| 6. | List the types of shift register. | | CO3 | R | 1 |
| 7. | Find the resolution for 8 bit ADC when 5V is supplied. | | CO4 | U | 1 |
| 8. | Identify the key performance parameters of a DAC. | | CO4 | R | 1 |
| 9. | List the main components of FPGA architecture. | | CO5 | U | 1 |
| 10. | Name the register in a microprocessor that holds the memory address of the next instruction to be executed. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Apply DeMorgan’s theorem for the given expression  (a) (b) | | CO1 | A | 3 |
| 12. | Develop a logic circuit with four input variables that will only produce a 1 output when exactly three input variables are 1s. | | CO2 | An | 3 |
| 13. | Develop the truth table for the active-HIGH input S-R latch. | | CO3 | An | 3 |
| 14. | Outline the importance of Sample and Hold circuit in ADC. | | CO4 | U | 3 |
| 15. | Differentiate between static RAM with dynamic RAM. | | CO5 | An | 3 |
| 16. | Explain the interrupt handling process in the 8085 microprocessor. | | 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. | Generate the truth table and draw the logic diagram for the Boolean expression A(B + CD). | CO1 | A | 6 |
|  | b. | Explain the operation of a CMOS inverter, focusing on its switching behavior, voltage transfer characteristics, and power consumption. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Simplify the Boolean function f=A'B'C'+A'BC'+AB'C'+ ABC' using K-Map. | CO2 | A | 6 |
|  | b. | In a smart lighting control system for a large office building, a central microcontroller generates a single control signal that needs to be routed to one of 8 different lighting zones. Each zone has its own actuator that turns the lights on or off based on the received signal. Develop a circuit using demultiplexers to distribute the single control signal from the microcontroller to the 8 lighting zones. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Examine the feedback mechanism in a 4-bit Johnson counter its impact on state transitions over eight clock cycles, starting from 0000. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the operation of successive approximation ADC with block diagram | CO4 | U | 6 |
|  | b. | Explain the operation of an R-2R ladder DAC and its resistor network in converting binary inputs into a proportional analog output voltage. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Develop a combinational circuit using PROM which accepts 3-bit binary and generates its equivalent Excess 3 code. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the operation of a 1-bit comparator by constructing its truth table and specifying how its outputs (A > B, A < B, and A = B) correspond to the input combinations. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Illustrate the operation of a SISO (Serial-In, Serial-Out) shift register with block diagram highlighting the sequential shifting of a data bit through each flip-flop stage with each clock pulse. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Imagine you are developing an industrial automation system where processing of real-time sensor data and controlling actuators are significant. With the 8085 microprocessor serving as the central processing unit, analyze its key functional blocks highlighting its contribution in achieving efficient data processing and control in your system. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the concepts of logic gates and tri state logic |
| **CO2** | Design Combinational Circuits using Boolean Logic |
| **CO3** | Implement Sequential Circuits using logic gates. |
| **CO4** | Outline the process of Analog to Digital conversion and Digital to Analog conversion. |
| **CO5** | Apply PLDs to implement the given logical problem. |
| **CO6** | Relate the concepts of Digital Systems to Microprocessor Architecture |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20RO2002** | **Duration** | **3hrs** |
| **Course Title** | **MECHANICS OF SOLIDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define factor of safety. | | CO1 | U | 1 |
| 2. | Define resilience. | | CO1 | R | 1 |
| 3. | Calculate the stress in a bar of cross-sectional area A subjected to force P. | | CO2 | A | 1 |
| 4. | Identify the type of stress acting on a bolt under torsion. | | CO2 | R | 1 |
| 5. | Describe the sign convention for bending moment in beam. | | CO3 | U | 1 |
| 6. | Define point of contraflexure in Bending Moment Diagram. | | CO3 | R | 1 |
| 7. | Explain the term neutral axis. | | CO4 | U | 1 |
| 8. | Write the equation of simple bending. | | CO4 | R | 1 |
| 9. | Identify the stress developed in a close-coiled spring under axial load. | | CO5 | U | 1 |
| 10. | Interpret the concept of *principal stress* in mechanics of materials. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A load of 15 kN is to be raised with the help of a steel wire. Compute the minimum diameter of the steel wire required, if the stress is not to exceed 250 N/mm2. | | CO1 | A | 3 |
| 12. | Distinguish between gradual and impact loading based on energy absorption. | | CO2 | U | 3 |
| 13. | Sketch the shear force diagram of a simply supported beam of length ‘l’, carrying a point load P at the center of the beam. | | CO3 | A | 3 |
| 14. | List the assumptions made in the theory of simple bending. | | CO4 | R | 3 |
| 15. | Derive the expression for section modulus of a hollow circular section. | | CO5 | A | 3 |
| 16. | Illustrate the sign conventions of principle stress and strain for analytical method. | | 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 specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. Find   1. The stress at elastic limit. 2. Young’s modulus. 3. Percentage elongation. 4. Percentage reduction in area. 5. Ultimate tensile stress | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the relationship between Modulus of Elasticity and bulk modulus. | CO3 | U | 6 |
|  | b. | Explain the features of stress-strain diagram for Ductile Material with neat sketch. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | A non-uniform tension bar 5 m long is made up of two parts as shown in Fig.    Find the total strain energy stored in the bar, when it is subjected to a gradual load of 70 kN. Also, find the total strain energy stored in the bar, when the bar is made of a uniform cross-section of the same volume under the same load. Take E = 200 GPa. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A cantilever of length 4m carries a UDL of 3 kN/m run over the whole length and two-point loads of 4kN and 2.5 kN are placed 1m and 2m respectively from the fixed end. Draw the SF and BM diagram. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | A beam of length 4m long is overhanging by 1m and carries load as shown in Figure. Draw the shear force and bending moment diagrams and also find the point of contraflexure. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A rolled steel joist of I-section has the dimensions as shown in the figure. This beam of I-section carries a uniformly distributed load (u.d.l.) of 40 kN/m over a span of 10 m. Calculate the maximum stress produced due to bending. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | A solid shaft of 120 mm diameter is required to transmit 200 kW at 100 r.p.m. If the angle of twist is not to exceed 2°, find the length of the shaft. Take modulus of rigidity for the shaft material as 90 GPa. | CO5 | A | 8 |
|  | b. | A closely-coiled helical spring of round steel wire 5 mm in diameter having 12 complete coils of 50 mm mean diameter is subjected to an axial load of 100 N. Find the deflection of the spring and the maximum shearing stress in the material. Modulus of rigidity C=80 GPa. | CO3 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The stresses at a point of a machine component are 100 MPa and 50 MPa both tensile. Find the intensities of normal stress, shear stress and resultant stress on a plane incline at an angle of 55o with the axis of major tensile stress. Also find the magnitude of the maximum shear stress in the machine component. | CO6 | A | 12 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the concepts of stress-strain relationships for homogenous, isotropic materials. |
| **CO2** | Calculate stresses and strains in members subjected to axial structural loads and thermal loads. |
| **CO3** | Determine the volumetric strain of the components and also derive the relationship between the elastic constants. |
| **CO4** | Calculate the shear force and bending moment of beams. |
| **CO5** | Compute the stresses and strains in members subject to flexural and torsional loadings. |
| **CO6** | Illustrate principal stresses, maximum shearing stress, and the stresses acting on a structural member. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20RO2003** | **Duration** | **3hrs** |
| **Course Title** | **SENSORS AND PROTOCOLS FOR INSTRUMENTATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is meant by hysteresis in sensor systems? | | CO1 | U | 1 |
| 2. | Define the term “accuracy” in measurement systems. | | CO1 | R | 1 |
| 3. | Name any two materials commonly used in Resistance Temperature Detectors (RTDs). | | CO2 | R | 1 |
| 4. | Mention one application of a piezoelectric pressure transducer. | | CO2 | R | 1 |
| 5. | State the principle behind a resistance potentiometer. | | CO3 | U | 1 |
| 6. | Differentiate between absolute and incremental encoders | | CO3 | R | 1 |
| 7. | Define a tactile sensor. | | CO4 | U | 1 |
| 8. | Write the principle of a Venturi flow meter. | | CO4 | R | 1 |
| 9. | What does KWP2000 stand for? | | CO5 | U | 1 |
| 10. | Mention the unit of frequency in the electromagnetic spectrum. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Briefly describe the factors to be considered in the selection of sensors. | | CO1 | U | 3 |
| 12. | List the advantages of Integrated Circuit (IC) temperature transducers. | | CO2 | U | 3 |
| 13. | Analyze the applications of photoelectric sensors by categorizing them based on sensing methods and application. | | CO3 | An | 3 |
| 14. | Describe the role of a gyroscope in measurement systems. | | CO4 | U | 3 |
| 15. | Explain the characteristics and uses of I2C communication. | | CO5 | U | 3 |
| 16. | Differentiate between WLAN and WPAN with examples. | | 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. |  | Evaluate the significance of calibration techniques in ensuring accurate sensor system performance. Also, assess the need for calibration and the role of standards in maintaining measurement reliability and consistency across measurement system. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Evaluate the effectiveness of resistive and capacitive pressure transducers in terms of design, accuracy, sensitivity, and application suitability. | CO2 | E | 6 |
|  | b. | Analyze the working principles of Thermistors, and Thermocouples. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Analyze the construction and working principle of an LVDT by identifying the role of each component and how they interact to produce the output signal. Further, examine how its design contributes to both its advantages and limitations. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the various methods for vibration measurement. Explain any one method with a neat diagram. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the application of different **Field Bus Protocols** such as Modbus, Profibus, and Ethernet in industrial automation. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Apply your understanding of Wi-Fi, Bluetooth, ZigBee, BLE, and 6LoWPAN in terms of range, data rate, energy consumption, and network topology. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the effectiveness of radio modems in wireless data communication systems. Assess their performance, reliability, and suitability in comparison with other wireless communication technologies. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design and develop an innovative application that integrates multiple serial data communication interfaces such as RS-232, RS-485, CAN, I2C, SPI, and I2S. Justify your design choices by comparing these interfaces in terms of architecture, communication speed, and application suitability. | CO5 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Classify the types of errors in measurement system and identify the types of sensors |
| **CO2** | Compare the principle and working of temperature, pressure and flow sensors |
| **CO3** | Identify and apply appropriate sensor for measurement of displacement and velocity |
| **CO4** | Apply various sensors for designing and building robots |
| **CO5** | Describe the functions of different communication protocols |
| **CO6** | Apply the various wireless communication protocols in Sensor Interfacing |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20RO3003** | **Duration** | **3hrs** |
| **Course Title** | **COMPUTER AIDED MODELING AND DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the application of CAD/CAM in Robotics and automation. | CO1 | A | 8 |
|  | b. | Explain IGES and STEP. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | A triangle has coordinates with A (5,2), B (3,5) and C (7,5). Interpret the new transformation points for the following conditions.   1. Rotate the triangle by 300 clockwise about the origin and then translate the triangle 2 units in X direction and 2 units in Y direction. 2. Translate the triangle 2 units in X direction and 2 units in Y direction and then rotate by 300 clockwise about the origin. | CO2 | A | 12 |
|  | b. | Explain painters algorithm for hidden surface removal. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 3. | a. | Compare Parametric and non-Parametric representations. | CO3 | An | 8 |
|  | b. | Explain various types of analytic surface entities for shape design and to represent complex objects. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. |  | Derive the parametric equation of Hermite curve and list its characteristics. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 5. | a. | Explain the product cycle and CAD/CAM product cycle. | CO4 | U | 8 |
|  | b. | Compare sequential and concurrent engineering. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | Describe the types of 2D elements used in finite element analysis. | CO5 | U | 4 |
|  | b. | Derive the natural coordinate of a one-dimensional bar element. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 7. |  | Explain the various optimization technique used in CAD modeling. | CO6 | An | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Design a thin-walled spherical vessel for maximizing gas storing capacity under pressure pi = 4 MPa and with the following considerations.  t < D, t = wall thickness; D = Mean diameter of the vessel; Factor of Safety = 3; Mass of the Vessel ≤ 125 kg. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the basic structure and components of cad. |
| CO2 | Outline the process of representing graphical entities in a cad environment. |
| CO3 | Construct the geometric model using different techniques to represent a product. |
| CO4 | Illustrate various techniques and devices involved in cad hardware. |
| CO5 | Analyze the models for design solutions using fem. |
| CO6 | Discuss the various computer aided tools implemented in various industrial applications. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20RO3004** | **Duration** | **3hrs** |
| **Course Title** | **DRIVES AND CONTROL SYSTEMS FOR AUTOMATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the principle and working of a stepper motor. | CO1 | U | 8 |
|  | b. | Explain the working principle of V/F control. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. |  | Describe the working principle of an AC servo motor. List out the advantages of servo motors in automation applications? Examine the control mechanism in induction and servo motors. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 3. | a. | A 3 phase **4-pole, 50 Hz** induction motor runs at **1440 RPM at full load**. Calculate a) The synchronous speed. b) The slip percentage.  c) If the motor runs at 5% slip, determine the rotor speed. | CO2 | E | 8 |
|  | b. | Explain the working principle of a linear motor with its main applications. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the working principle of a belt and pulley system. | CO3 | U | 8 |
|  | b. | Explain different types of control systems used in industrial robots. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the memory details of PLC. | CO4 | U | 8 |
|  | b. | Sketch the block diagram of PLC and explain. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Describe different types of counters used to program PLC with suitable example. | CO5 | A | 8 |
|  | b. | Develop a ladder program for wood saw cutter.   1. A wood saw cutter (W), a fan (F) and a lubrication pump (P) turns on when a START push button is pushed. Following is the stopping sequence: 2. STOP push-button stops the saw only before fan stops it should run for an additional 5 sec to blow the chips away and also the tube pump is to run for 8 sec. 3. Additionally, before it stops. if the saw has run more than 1 min, the fan should stay ON indefinitely. The fan may be turned OFF by pushing a separate fan reset switch. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | State the need of HMI in industrial automation and explain its types. | CO5 | U | 8 |
|  | b. | Differentiate between relay logic and PLC. | CO5 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain various components involved in SCADA system with sketch. | CO6 | U | 10 |
|  | b. | Explain Profibus and HART protocol. | CO6 | U | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Describe the working principles of various types of motors, differences, characteristics and selection criteria. |
| CO2 | Apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications |
| CO3 | Explain control methods of special drives |
| CO4 | Elucidate various linear and rotary motion principles and methods and use the same to application areas |
| CO5 | Design programming using PLC and use of various PLCs to Automation problems in industries. |
| CO6 | Discuss supervisory control and data acquisition method and use the same in complex automation areas. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20RO3018** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL INTELLIGENCE IN ROBOTICS AND AUTOMATION** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain the concepts of Intelligent agents and describe the various types of intelligent agents with suitable examples. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Illustrate the minimax algorithm and the alpha-beta pruning technique applied to overcome its limitations with suitable state space representations. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. |  | Sketch the architecture of a knowledge-based agent and explain the inference system to generate new facts to update the knowledge base. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Discuss the Ant Colony Optimization (ACO) for routing problems. | CO4 | U | 8 |
|  | b. | Classify the types of learning methods adopted in AI and brief them. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 5. |  | Explain the impact of ethical principles on the design process of AI systems. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the depth first and breadth first strategy with suitable state space representations. | CO1 | A | 8 |
|  | b. | Solve the following crypt-arithmetic problem with the constraint satisfactions.  SEND  + MORE  MONEY | CO2 | A | 8 |
|  |  |  |  |  |  |
| 7. |  | Describe Bayesian networks and probabilistic reasoning with a real-world example. | CO3 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain the robustness and transparency of AI systems with examples. Highlight their importance in designing trustworthy robotic surgery systems | CO6 | U | 10 |
|  | b. | Examine the application of AI in human resource management, focusing on recruitment, talent management, and employee engagement. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basics of AI. |
| CO2 | Understand the various intelligent search methods. |
| CO3 | Explain the concepts of knowledge and reasoning. |
| CO4 | Understand the in-depth concepts of learning methods. |
| CO5 | Explore the ethics of AI. |
| CO6 | Understand the application of AI for robotics. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **22RO1001** | **Duration** | **3hrs** |
| **Course Title** | **MATERIAL SCIENCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define atomic structure. | | CO1 | U | 1 |
| 2. | State the three types of metallic crystal structures. | | CO1 | R | 1 |
| 3. | Identify at what temperature Iron changes its structure from BCC to FCC? | | CO2 | R | 1 |
| 4. | Interpret the purpose of phase diagrams. | | CO2 | R | 1 |
| 5. | Mention the function of the valence band in solids. | | CO3 | U | 1 |
| 6. | Define the principle of magnetostriction. | | CO3 | R | 1 |
| 7. | Mention any two dielectric fluid used in EDM. | | CO4 | U | 1 |
| 8. | Explain the solid solution strengthening principle. | | CO4 | R | 1 |
| 9. | List any two properties of Type II superconductors with examples. | | CO5 | U | 1 |
| 10. | Identify the phase of liquid crystals used in LCD screens. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the principle of solubility limits in materials with an example. | | CO1 | An | 3 |
| 12. | Describe the effect of interstitial diffusion with neat sketch. | | CO2 | U | 3 |
| 13. | List the functions of Dielectric Fluid used in electric discharge machining process. | | CO3 | U | 3 |
| 14. | Distinguish between elastic and plastic deformation in metals. | | CO4 | An | 3 |
| 15. | Compare soft and hard ferromagnetic materials with suitable examples. | | CO5 | An | 3 |
| 16. | Describe the importance of biomimetic materials in medical and industrial applications. | | 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 features of BCC, FCC, and HCP crystal structures and mention metals that exhibit these structures. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Specify the assumption of classical free electron theory. | CO2 | R | 6 |
|  | b. | Describe the process in which the band theory defines the conductivity in metals and insulators. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the different phases in Iron carbon diagram with microstructural changes on cooling. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the major components of plasma arc machining system in detail and draw its schematic diagram. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the major components of the electron beam machining system in detail and draw its schematic diagram. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the working principle of the Rockwell hardness test. | CO5 | U | 8 |
|  | b. | Mention the factors that influence creep resistance in metals. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 23. | a. | Describe the S-N curve and discuss its importance in evaluating fatigue life of materials and analyze the influence of endurance limit and fatigue strength in material selection. | CO5 | An | 8 |
|  | b. | Explain the magnetic flux leakage method used in magnetic particle testing and analyze magnetic field lines get affected by a discontinuity in material affect | CO5 | An | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain thermotropic liquid crystal in detail and its applications. | CO6 | A | 6 |
|  | b. | Explain biomimetic materials properties and applications in detail. | CO6 | An | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the various phase diagrams and their applications |
| **CO2** | Explain the applications of Ferrous alloys |
| **CO3** | Discuss about the electrical properties of materials |
| **CO4** | Summarize the mechanical properties of materials and their measurement |
| **CO5** | Differentiate magnetic, dielectric and superconducting properties of materials |
| **CO6** | Outline the application of modern engineering materials |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **22RO2003** | **Duration** | **3hrs** |
| **Course Title** | **SENSOR SIGNAL CONDITIONING CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define an input bias current and its impact on the circuit performance. | | CO1 | R | 1 |
| 2. | A differential amplifier has a differential voltage gain of 2000 and common mode gain of 0.2. Determine CMRR. | | CO1 | R | 1 |
| 3. | Enumerate the applications of a comparator. | | CO2 | R | 1 |
| 4. | State the limitations of an ideal integrator. | | CO2 | R | 1 |
| 5. | Sketch the circuit diagram for a multiplier circuit | | CO3 | A | 1 |
| 6. | List any two applications of an astable multivibrator using IC 741 opamp. | | CO3 | R | 1 |
| 7. | Nme any two types of active filter. | | CO4 | R | 1 |
| 8. | List any two applications of a monostable multivibrator using IC 555 timer. | | CO4 | R | 1 |
| 9. | Define resolution of a data convereter | | CO5 | R | 1 |
| 10. | List the advantages of an integrated circuit. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Develop an op-amp summing amplifier that produces Vo=−(0.5V1+2V2+5V and discuss how resistor values determine its performance. | | CO1 | A | 3 |
| 12. | Illustrate an op-amp differentiator circuit and describe how resistor and capacitor values affect its frequency response. | | CO2 | A | 3 |
| 13. | Differentiate a Schmitt trigger and a comparator circuit. | | CO3 | U | 3 |
| 14. | Differentiate between low pass and high pass filter. Sketch the frequency response plot. | | CO4 | U | 3 |
| 15. | Calculate the frequency and duty cycle for a 555 timer astable multivibrator with R1=10Kohm, R2= 5K ohm and C=0.01 μF. | | CO5 | A | 3 |
| 16. | Enumerate the advantages of ICs over discrete component circuits. | | 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 key DC characteristics of an operational amplifier and discuss the impact of its circuit performance. | CO1 | U | 8 |
|  | b. | Derive the voltage gain expression of an inverting amplifier and interpret its significance in circuit design. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the circuit diagram of an instrumentation amplifier featuring adjustable gain control and elucidate the operational concept behind its variable gain functionality. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Interpret the functional diagram of a 741-based monostable multivibrator and compute its oscillation frequency and also illustrate the process with corresponding waveforms. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the circuit diagram of a second-order Butterworth active low-pass filter, derive its transfer function, and analyze the key characteristics of a second-order low-pass filter. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the operation of 555 timer as an astable multivibrator using a functional diagram and derive the frequency expression for oscillation with relevant waveforms. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the Wien bridge oscillator circuit, derive its oscillation frequency expression, and evaluate how resistor and capacitor values influence the frequency. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the operation of the basic PLL with schematic diagram. | CO5 | U | 6 |
|  | b. | Explain how IC 565 PLL can be used as a FSK demodulator. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Construct the functional diagram of flash type ADC and explain its integrated output waveform. Also compare flash type ADC with successive approximation type ADC. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Infer operational amplifiers' DC and AC characteristics. |
| CO2 | Discuss the linear and non-linear applications for an op-amp. |
| CO3 | Classify the working of multivibrators using the general-purpose op-amp and specific application IC 555. |
| CO4 | Outline the functionalities of specific ICs such as voltage regulators and PLLs. |
| CO5 | Demonstrate the working of data converters. |
| CO6 | Summarize the techniques of IC fabrication |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **22RO2011** | **Duration** | **3hrs** |
| **Course Title** | **ROBOTIC PROCESS AUTOMATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Robotic Process Automation. | | CO1 | R | 1 |
| 2. | Recall the history of RPA. | | CO1 | R | 1 |
| 3. | Classify the types of recordings available in UiPath. | | CO2 | U | 1 |
| 4. | List the components of UiPath. | | CO2 | R | 1 |
| 5. | Define sequencing in RPA workflows. | | CO3 | R | 1 |
| 6. | List the various type of loops used in RPA. | | CO3 | R | 1 |
| 7. | State the advantages of scraping the screen. | | CO4 | U | 1 |
| 8. | Label the port number of SMTP Gmail. | | CO4 | R | 1 |
| 9. | Name the email protocol in Uipath. | | CO5 | R | 1 |
| 10. | Classify sequences and flowchart**.** | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the benefits of RPA. | | CO1 | R | 3 |
| 12. | List the advantages of ‘get password’ activity. | | CO2 | R | 3 |
| 13. | Define sequencing in RPA workflow | | CO3 | R | 3 |
| 14. | Define OCR in RPA. | | CO4 | R | 3 |
| 15. | Identify the role of anchors in PDF automation. | | CO5 | U | 3 |
| 16. | Define Orchestrator in RPA. | | 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. |  | Interpret the application of RPA in improving the productivity of an organization. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the browser automation using UiPath-Recording. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Sketch the process flow diagram of finding even numbers using UiPath activity. | CO3 | A | 6 |
|  | b. | Explain the significance of variables and arguments in automation. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the addition of two numbers by passing variables and arguments. | CO3 | A | 6 |
|  | b. | Develop an RPA workflow using sequence and flowchart techniques. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Summarize the RPA Challenge in automation of data entry process. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the process flow of PDF automation using UiPath . | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Illustrate the method to streamline email communication using UiPath. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the future trends and orchestrator in UiPath. | CO6 | A | 6 |
|  | b. | Explain the impact of AI and machine learning in RPA. | CO6 | A | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Relate RPA, where it can be applied and how it's implemented. |
| **CO2** | Outline the different types of variables, Control Flow and data manipulation techniques. |
| **CO3** | Identify and understand Image, Text and Data Tables Automation. |
| **CO4** | Interpret how to handle the User Events and various types of Exceptions and strategies. |
| **CO5** | Illustrate the RPA interfacing aspects with E-mail Automation |
| **CO6** | Understand the Deployment of the Robot and to maintain the connection. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23RO1003** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF PYTHON PROGRAMMING FOR ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List different types of data types available in Python. | | CO1 | U | 1 |
| 2. | Find the output for the following code.  string1 = "Robotics"  string2 = "Engg"  print(string1 + string2) | | CO1 | U | 1 |
| 3. | Name the keyword used to skip the current iteration of a loop. | | CO2 | R | 1 |
| 4. | Identify the purpose of the split() method in Python. | | CO2 | R | 1 |
| 5. | State the difference between 'r' and 'rb' file modes. | | CO3 | U | 1 |
| 6. | Identify the method used to access a substring from a string in Python. | | CO3 | R | 1 |
| 7. | Name the method used to add a new key-value pair to a dictionary. | | CO4 | R | 1 |
| 8. | Identify the function used to find the maximum value in a list. | | CO4 | R | 1 |
| 9. | Name the OOP principle that allows a subclass to reuse attributes and methods from a parent class. | | CO5 | R | 1 |
| 10. | Name the library used in MicroPython to control GPIO pins. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the role of indentation in Python. | | CO1 | U | 3 |
| 12. | Develop a Python program to print the first 10 characters of a given string. | | CO2 | An | 3 |
| 13. | Write a Python program to read the contents of a text file and print each line separately. | | CO3 | A | 3 |
| 14. | Differentiate between del, remove(), and pop() functions in Python lists. | | CO4 | U | 3 |
| 15. | Write a simple Tkinter program to create a window with a label and a button. | | CO5 | A | 3 |
| 16. | Explain the role of PWM in controlling servo motors in a pick-and-place robot. | | 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. | Develop a Python program that accepts two numbers and an operator (+, -, \*, /) from the user and computes the result based on the selected operation. | CO1 | An | 6 |
|  | b. | A software development company is building an interactive Chabot using Python. The chabot takes user input, processes the response, and provides an appropriate reply. The developers need to ensure that user inputs are correctly stored, processed, and displayed while handling different data types such as integers, floats, and strings. **Develop a Python program that:**   * Accepts user input for their name and age. * Stores the values using appropriate data types. * Displays a welcome message using string concatenation. * Convert the age input into an integer | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | A text analysis tool needs to identify how many times the word "Python" is mentioned in a programming blog. Develop a Python program using the count() method to find the frequency of the word. | CO2 | An | 6 |
|  | b. | A vending machine allows users to select items and deducts the amount from their balance. If the balance is insufficient, it denies the purchase. Write a Python program using loops to simulate the machine. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Develop a Python program that extracts all numbers from a given text file, sums them up, and writes the result to another file. | CO3 | An | 6 |
|  | b. | An airline maintains passenger information in a text file. Write a Python program to search for a specific passenger's name and print the details if found. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Write a Python program for a student management system that collects student names and grades, stores them in a dictionary, and displays the student with the highest grade. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Develop a Python program for a vehicle rental system with a base class Vehicle and subclasses Car and Bike. Include methods for renting and returning vehicles. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Develop a Python program that merges two lists into a dictionary, where one list contains keys and the other contains corresponding values. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | A company wants to store employee records in a file, where each line contains an employee’s name and salary separated by a comma. Write a Python program to add new employee records to the file and display all records. | CO3 | A | 6 |
|  | b. | An online exam system requires students to answer a quiz. The system should keep asking a question until the correct answer is given or the user decides to quit. Write a Python program using if conditions to implement this task. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A home automation company is developing a smart door monitoring system using an ESP32 board and MicroPython. The system should detect motion using an ultrasonic sensor and turn on an LED if a person is detected within a certain distance. Additionally, it should log the detection time into a text file stored on the ESP32 board. Write a MicroPython program to implement this functionality. Ensure that the system continuously monitors motion, turns the LED on when motion is detected, and logs the detection event with a timestamp. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Outline the structure and components of a python program. |
| **CO2** | Describe loops and decision statements in python. |
| **CO3** | Illustrate class inheritance in python for reusability. |
| **CO4** | Apply lists, tuples and dictionary concepts in python programs. |
| **CO5** | Assess object‐oriented programs with python classes and GUI. |
| **CO6** | Develop simple codes for robotic applications. |