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

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| --- | --- | --- | --- |
| **Course Code** | **18EC2021** | **Duration** | **3hrs** |
| **Course Title** | **MICROWAVE AND OPTICAL COMMUNICATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Classify microwave bends. | | CO1 | U | 1 |
| 2. | What is waveguide? | | CO1 | R | 1 |
| 3. | Recall the function of coupling mechanism of aperture. | | CO2 | R | 1 |
| 4. | Define scattering matrix. | | CO2 | R | 1 |
| 5. | Why the output cavity is called as catcher cavity? | | CO3 | U | 1 |
| 6. | Name any two application of TWT amplifier. | | CO3 | R | 1 |
| 7. | List the modes available in avalanche device? | | CO4 | U | 1 |
| 8. | Name the different methods to measure power. | | CO4 | R | 1 |
| 9. | For n1 = 1.55 and n2 =1.52 Calculate the critical angle. | | CO5 | U | 1 |
| 10. | Why silicon is preferred for fabrication of photo receiver? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate adapters and couplers in microwave. | | CO1 | An | 3 |
| 12. | Derive the S-Matrix of H-plane tee when power is fed from auxiliary port. Consider other ports in the matched condition. | | CO2 | U | 3 |
| 13. | A two cavity klystron amplifier has the following parameters: V0 = 1000 V. Calculate the Electron Velocity (v0). | | CO3 | An | 3 |
| 14. | Compare IMPATT and TRAPATT diode. | | CO4 | U | 3 |
| 15. | Draw the diagram of Step Index fiber and Graded Index fiber. | | CO5 | An | 3 |
| 16. | Illustrate the need of photodetector in optical communication. | | 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 in detail about the following with neat diagram   1. Matched termination 2. Microwave corner, bends and twists | CO1 | An | 12 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 18. |  | Using the properties of scattering matrix of a lossless, reciprocal microwave junction, justify that for a four port network if all the four ports are matched, the device shall be a directional coupler. Also Derive the S-matrix for directional coupler. | CO2 | E | 12 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 19. | a. | With neat diagram explain the working principle of two cavity klystron amplifier using velocity modulation and write the power efficiency of it. | CO3 | A | 8 |
|  | b. | Write the applications of klystron amplifier. |  | R | 4 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the operation of cylindrical magnetron oscillator with necessary diagram. | CO4 | U | 8 |
|  | b. | Mention how a TWT can be converted to backward oscillator. |  | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain the construction and operation of Gunn diode with neat sketch. | CO4 | U | 10 |
|  | b. | **How to Interpret the Graph for Negative Resistance?** |  | U | 2 |
|  |  |  |  |  |  |
| 22. | a. | Calculate the NA of a fiber having n1 = 1.6 and n2 = 1.49 and another fiber having n1 = 1.448 and n2 = 1.405. Which fiber has greater acceptance angle? | CO5 | An | 8 |
|  | b. | Point out the limitations of optical fiber communication system. |  | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | How is slotted line used for measurement of impedance of an unknown load? Explain. | CO4 | U | 8 |
|  | b. | Describe a microwave bench. |  | R | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss in detail about avalanche photodetector. | CO6 | C | 8 |
|  | b. | Compare and contrast between surface and edge emitting LEDs. |  | An | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the operation of passive waveguide components |
| **CO2** | Distinguish the limitations of existing vacuum tubes and solid state devices at microwave frequencies |
| **CO3** | Predict the performance of specialized microwave tubes such as klystrons, reflex klystron, magnetron and Travelling wave tube |
| **CO4** | Classify microwave circuits using scattering parameters |
| **CO5** | Relate the characteristics of Optical Fiber components |
| **CO6** | Summarize optical source, Fiber and Detector operational parameters |

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

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| **Course Code** | **18EC3001** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED DIGITAL SIGNAL PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Determine the 8 point DFT of the input x[n]={4,3,2,1,1,2,3,4} using DIT-FFT algorithm. | CO1 | A | 15 |
|  | b. | Explain one to one mapping and many to one mapping in digital filter design. | CO1 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Develop polyphase decompositions for FIR filters and explain their significance in multirate systems. | CO2 | C | 10 |
|  | b. | Illustrate three level sub-band encoding and decoding process with neat diagrams. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | Analyze the Wiener–Hopf equations for an optimum FIR filter and their role in achieving minimum mean square error. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Interpret the LMS algorithm and the impact of the step-size parameter on its convergence. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate the effectiveness of the periodogram method for spectrum estimation. | CO5 | E | 15 |
|  | b. | Differentiate between parametric and non-parametric methods of spectrum estimation. | CO5 | U | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the block diagram of a two-channel filter bank and describe its functioning. | CO2 | An | 10 |
|  | b. | Compare direct sampling-rate conversion methods with multistage conversion techniques. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 7. |  | Construct the cascade and parallel realization of the system described by y(n)-(1/4)y(n-1)-(1/8)y(n-2)=x(n)+3x(n-1)+2x(n-2) | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Develop the Minimum Variance (MV) spectral estimation technique and explain its advantages. | CO5 | C | 10 |
|  | b. | Illustrate practical applications of adaptive filtering in echo cancellation, channel equalization, and ECG noise removal. | CO4 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss various spatial and frequency-domain filtering methods used in image processing. | CO6 | U | 10 |
|  | b. | Illustrate the steps involved in speech coding with a neat block diagram. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Compute the digital filter coefficients for given specification |
| CO2 | Recognize the need for Multi-rate signal processing applicable to communication systems |
| CO3 | Distinguish various types of prediction methods |
| CO4 | Explore the usefulness of adaptive filters in communication systems |
| CO5 | Compute the power spectrum estimation using various methods |
| CO6 | Infer the relevance and significance of Signal Processing in various applications |

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

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| **Course Code** | **18EC3013** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED DIGITAL IMAGE PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the steps involved in digital image processing and evaluate their role in enhancing human visual perception. | CO1 | R | 10 |
|  | b. | Illustrate the structure of the human eye and explain how it relates to visual perception in image processing applications. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the properties of DFT and analyze how it supports image enhancement in the frequency domain. | CO2 | An | 10 |
|  | b. | Explain cosine and sine transforms and evaluate their significance in image enhancement. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the effect of erosion and dilation on object boundaries and evaluate their significance in image segmentation. | CO3 | An | 10 |
|  | b. | Explain edge detection models and discuss how they support texture-based feature extraction. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the basic concept of image registration and analyze the role of transformation functions in aligning images. | CO4 | An | 10 |
|  | b. | Evaluate the differences between pixel-based and region-based image fusion techniques. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain 3D image visualization techniques and analyze their applications in volumetric data interpretation. | CO5 | A | 10 |
|  | b. | Illustrate stereo viewing and ray tracing methods in 3D image processing. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Analyze the challenges in integrating virtual reality with 3D image processing application. | CO6 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Apply wavelet-based segmentation for shape and texture feature extraction and discuss its advantages. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Apply spatial domain filtering techniques and analyze their effect on image enhancement. | CO2 | A | 10 |
|  | b. | Analyze the process of volumetric display and ray tracing in 3D image processing with neat diagrams. | CO5 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Apply the concept of scene understanding to analyze natural images in real-world scenarios. | CO6 | A | 10 |
|  | b. | Explain the application of abnormality detection techniques in medical images using image processing methods. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the basic concepts of image formation and representation |
| CO2 | Design techniques for enhancing the quality of the images |
| CO3 | Frame morphology-based methodologies for image segmentation |
| CO4 | Assess the performances of various image registration approaches |
| CO5 | Differentiate the concepts of 2D and 3D image processing approaches |
| CO6 | Solve practical problems using image processing techniques |

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

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| **Course Code** | **18EC3014** | **Duration** | **3hrs** |
| **Course Title** | **PATTERN RECOGNITION AND MACHINE LEARNING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the design cycle of pattern recognition and its various applications. | CO1 | U | 10 |
|  | b. | Analyze the importance of maximum likelihood and Bayesian approach in parameter estimation for statistical inference. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Calculate the coefficients of the simple linear regression model of the form y=a0+a1x for the given dataset and estimate the output for x=50**.**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | X | 2 | 5 | 10 | 14 | 15 | 20 | | Y | 3 | 6 | 11 | 15 | 17 | 19 | | CO2 | A | 10 |
|  | b. | Explain the fundamental principles of Logistic Regression with its primary purpose, the mathematical function employed, the parameter estimation, and the interpretation of its results. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. |  | Differentiate single and multilayer perceptron and elaborate the concept of backpropagation in multilayer perceptron | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the objective and functionality of the Support Vector Machine (SVM) maximum margin classifier, explaining the role of the Kernel Trick in handling non-linearly separable data, and identify a critical application. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the fundamental reasons that enable the combination of multiple weak classifiers into an ensemble to yield significantly better predictive performance than a single complex model. | CO5 | An | 10 |
|  | b. | Discuss the roles of bias, variance, and model stability in justifying ensemble methods. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the working principles of AdaBoost with neat diagram. | CO3 | U | 10 |
|  | b. | Describe the core principle of Linear Discriminant Analysis (LDA) in maximizing class separability. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Examine the conceptual shift from traditional Machine Learning to Deep Learning, outlining its core structure and the purpose of activation functions in a deep learning model. | CO3 | An | 10 |
|  | b. | Elucidate the working principle of Ho-Kashyap procedure in solving the linear discriminant function. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Apply K-Means clustering algorithm to group the following dataset into 2 clusters and calculate the updated cluster centroids after one iteration. Assume the initial cluster centroids as (185,72), (170,56).   |  |  |  | | --- | --- | --- | | **ID** | **Height** | **Weight** | | 1 | 185 | 72 | | 2 | 170 | 56 | | 3 | 168 | 60 | | 4 | 179 | 68 | | 5 | 182 | 72 | | 6 | 188 | 77 | | CO6 | A | 10 |
|  | b. | Differentiate between parametric and non-parametric learning in pattern recognition. | CO1 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Differentiate soft & hard clustering and explain the stepwise procedure of Fuzzy K-means clustering algorithm. | CO6 | An | 10 |
|  | b. | Discuss the various categories of machine learning algorithms to solve the real-world problems. | CO6 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the basics of pattern recognition and machine learning |
| CO2 | Illustrate the linear models for classification |
| CO3 | Select the neural network for classification |
| CO4 | Summarize the concept of linear discriminant function |
| CO5 | Design algorithm independent machine learning |
| CO6 | Develop unsupervised learning techniques and clustering |

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

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| **Course Code** | **18EC3026** | **Duration** | **3hrs** |
| **Course Title** | **INTERNET OF THINGS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Compare IPv4 and IPv6 addressing schemes in the context of IoT applications. How do M2M (Machine-to-Machine) and peer-to-peer networking concepts enable large-scale IoT communication and interoperability? | CO1 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the role of Software Defined Networking (SDN) in enabling efficient IoT communication. Discuss the transition from Cloud to Fog and MIST computing with a detailed architecture diagram. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Design an IoT network for a smart agriculture system that involves sensor deployment, edge resource pooling, and client-side configuration. Explain how data flows from sensors to the cloud in this system. | CO3 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain how smart objects serve as the building blocks of IoT. Discuss the role of open-source hardware platforms (like Arduino, Raspberry Pi, ESP32) and embedded systems in IoT development. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss the operating system requirements for IoT devices. Explain how big data integration enhances IoT applications, providing examples from healthcare or transportation systems. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss in detail the evolution from IT to IoT. Explain how IoT revolutionizes smart cities with suitable examples, and elaborate on the concept of fractal cities in this context. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Analyze the architecture and functioning of Wireless Sensor Networks (WSNs) in IoT. Discuss how PAN, LAN, and WAN are integrated to form an effective IoT communication network. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate the security, privacy, and legal issues in IoT applications. Discuss how the IT Act 2000 supports or limits IoT legislation, and propose extensions or amendments to strengthen IoT governance. | CO6 | E | 20 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Examine the role of IoT in transforming transportation, smart grids, and healthcare systems. Discuss with relevant real-world applications, architectures, and performance outcomes. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Summarize the evolution of IoT |
| CO2 | Classify IoT technologies that are used now |
| CO3 | Explain the requirement of IoT in certain scenarios |
| CO4 | Choose appropriate technologies to tackle scenarios using experimental platform for implementing prototypes |
| CO5 | Use the types of technologies that are available to implement IoT solutions. |
| CO6 | Examine IoT applications. |

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

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| **Course Code** | **19EC2001** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRONICS FOR INTELLIGENT MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define automation. | | CO1 | R | 1 |
| 2. | List the challenges of industry 3.0. | | CO1 | R | 1 |
| 3. | List an example of Cyber Physical System. | | CO2 | R | 1 |
| 4. | Identify the design methodology that provides a solution-based approach for solving problems. | | CO2 | U | 1 |
| 5. | Define IoT. | | CO3 | R | 1 |
| 6. | Interpret the challenges of cloud data computing. | | CO3 | U | 1 |
| 7. | Define sensor. | | CO4 | R | 1 |
| 8. | List the layers of IoT architecture. | | CO5 | R | 1 |
| 9. | List the applications of GPS. | | CO5 | U | 1 |
| 10. | List an example of generative AI application. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare Industry 3.0 with Industry 4.0. | | CO1 | An | 3 |
| 12. | Describe the evolution of machine intelligence. | | CO2 | U | 3 |
| 13. | Interpret machine to machine communication. | | CO3 | A | 3 |
| 14. | Define sensor detection range and calculate the sensing period of proximity sensor. | | CO4 | An | 3 |
| 15. | Summarize the importance of data security in cloud computing. | | CO5 | U | 3 |
| 16. | Analyze the role of sustainability practices in supply chain management. | | 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. | Interpret the process of design thinking with suitable example. | CO1 | A | 8 |
|  | b. | Discuss the importance of industrial revolution towards the economic growth. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. |  | Assess the impact of advancements in AI technology on various industries and evaluate the ways in which these changes are reshaping traditional industry standards. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Design a smart home system that connects multiple devices using IoT standards. | CO3 | C | 12 |
|  |  |  |  |  |  |
| 20. |  | Design a measurement system using sensors to monitor environmental conditions in smart agriculture. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | Develop a data storage and recovery plan using cloud computing for an organization managing sensitive financial data ensuring data security, compliance, and quick recovery in the event of a system failure. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. | a. | Summarize the impact of GPS technology in the development of Google map. Illustrate with an example. | CO4 | E | 8 |
|  | b. | Explain the 3V’s of big data. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Design a GSM-based communication system for rural healthcare services to support remote diagnosis and patient monitoring. | CO4 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design an autopilot system for a battery operated car and illustrate the technical components required for navigation, communication, and safety features. | CO6 | C | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | To compare the different industry standards |
| **CO2** | To articulate the structure of an Intelligent machines |
| **CO3** | To illustrate the M2M interface needed in Intelligent machining |
| **CO4** | To be able to categorize the sensors for various Intelligent machines |
| **CO5** | To assess the data requirements for cloud storage |
| **CO6** | To be able to grade various types of Intelligent machines |

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

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| **Course Code** | **19EC2028** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF WIRELESS COMMUNICATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give two examples of Hard delay constraint in wireless systems. | | CO1 | U | 1 |
| 2. | Recognize the spectrum allotted for FM radio. | | CO1 | R | 1 |
| 3. | Relate Path loss (Db.) to distance d. | | CO2 | U | 1 |
| 4. | List the techniques commonly used to improve the capacity of cellular system. | | CO2 | R | 1 |
| 5. | Name the scientist responsible for demonstrating the physical existence of the radio waves. | | CO3 | R | 1 |
| 6. | Define Critical distance. | | CO3 | R | 1 |
| 7. | Represent delay spread due to multipath channel diagramatically. | | CO4 | U | 1 |
| 8. | Define Level crossing rate. | | CO4 | R | 1 |
| 9. | Identify the fading if the signal bandwidth B << Bc. | | CO5 | U | 1 |
| 10. | State the uses of cyclic prefix codes. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Interpret Cross layer mechanism with an example. | | CO1 | U | 3 |
| 12. | Define Co-channel cells. What are the possible number of co-channels in a cell? | | CO2 | R | 3 |
| 13. | Indicate the receive power fall of in the free space model with respect to distance d and frequency f. | | CO3 | U | 3 |
| 14. | With necessary diagrams, explain the response of a time-variant multipath channel to a very narrow pulse. | | CO4 | U | 3 |
| 15. | Indicate the important characteristics of the narrowband channel. | | CO5 | U | 3 |
| 16. | State the uses of OFDM. | | 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. | Compare and contrast the various Wi-Fi generations. | CO1 | An | 6 |
|  | b. | Tabulate the licensed and unlicensed spectrum allocations. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | During Cell splitting, if the cell radius of the new cells is reduced by half, estimate the required transmit power for these new cells. | CO2 | An | 6 |
|  | b. | Illustrate 120° sectoring for capacity improvement with a suitable figure. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | The path loss exponent for the simplified path loss model that best fits the measurements in Table below is γ =3.71. Assuming the simplified path loss model with this exponent and the K = −31.54 dB, Compute σ2ψdB, the variance of log-normal shadowing about the mean path loss based on these empirical measurements. Also find the standard deviation of shadow fading on this path σψdB. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate multipath channel with examples and the resultant multipath components. | CO4 | A | 6 |
|  | b. | Interpret the important characteristics of the wideband channel with suitable equations. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the Capacity in additive white Gaussian noise (AWGN) channel. | CO5 | U | 6 |
|  | b. | Consider a time-invariant frequency-selective block fading channel consisting of three subchannels of bandwidth B = 1 MHz. The frequency response associated with each channel is H1 = 1, H2 = 2 and H3 = 3. The transmit power constraint is P = 10 mW and the noise PSD is N0 = 10−9 W/Hz. Determine the Shannon capacity of this channel and the optimal power allocation that achieves this capacity. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Summarize the technical challenges faced by the wireless communication system. Enlist the emerging wireless systems. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the channel assignment strategies of cellular systems. | CO2 | An | 6 |
|  | b. | Describe umbrella cells. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With a neat block diagram, explain multi carrier modulation. State the advantages of multi carrier modulation. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Explain the concepts of wireless communication. |
| **CO2** | Interpret the various propagation models and channel models. |
| **CO3** | Identify various transceivers and its multiple access. |
| **CO4** | Model multichannel response. |
| **CO5** | Develop design of wireless system. |
| **CO6** | Analyze wireless channel capacity. |

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

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| **Course Code** | **19EC2029** | **Duration** | **3hrs** |
| **Course Title** | **DATA SCIENCE AND DATA ANALYTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate the data quality issues. | | CO1 | R | 1 |
| 2. | Describe the significance of box plot. | | CO1 | U | 1 |
| 3. | List the sources of primary data. | | CO2 | R | 1 |
| 4. | Discuss the advantages of Hadoop. | | CO2 | U | 1 |
| 5. | Name the commonly used hypothesis tests. | | CO3 | R | 1 |
| 6. | Distinguish between regression and classification. | | CO3 | U | 1 |
| 7. | Classify data visualization techniques based on the nature of data. | | CO4 | U | 1 |
| 8. | Define “lie factor”. | | CO4 | R | 1 |
| 9. | List any two data visualization software. | | CO5 | R | 1 |
| 10. | Name three programming languages supported by Apache Spark. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Summarize the three “V” from the Gartner Big Data definition. | | CO1 | U | 3 |
| 12. | Illustrate the measures of central tendency. | | CO2 | A | 3 |
| 13. | Distinguish between supervised models and unsupervised models. | | CO3 | A | 3 |
| 14. | Discuss the importance of color and scaling in visualization. | | CO4 | U | 3 |
| 15. | Summarize the significance of R-Language. | | CO5 | U | 3 |
| 16. | Relate the dataframes and datasets with RDD in Apache Spark. | | 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. | **Develop** an EDA storyboard with 5 visuals that together cover: **shape**, type, missing value**, spread**, relations, and **class separation.**  (for your own dataset) | CO1 | A | 8 |
|  | b. | Distinguish between quantitative and qualitative types of data. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. |  | Analyse the roles and interactions of Hadoop’s HDFS and YARN components and explain Hadoop architecture. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Implement the linear regression algorithm on a small dataset and report its performance. | CO3 | A | 8 |
|  | b. | Examine the Measures of shape and list out the practical uses. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate different charts to visualize a data set of your choice and give the detailed explanation of observations from charts. | CO4 | An | 8 |
|  | b. | Analyze common challenges encountered in information visualization, such as data overload, integration issues, or user misinterpretation. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Appraise the various toolkits in Python used for data science. | CO5 | An | 8 |
|  | b. | Distinguish between Python and R Language. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. |  | Analyze each phase in data science workflow and explain how it contributes to effective data representation and insight extraction. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Apply the visual variables to represent the data in an effective way. | CO4 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compose the data collection strategies to be carried out by the data analyst and discuss the practical advantages and disadvantages of the data collection strategies. | CO6 | C | 8 |
|  | b. | Discuss various commands available for the transformation and actions activities in Apache Spark. | CO6 | U | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the key concepts in data science, its applications and the toolkit used by data scientists |
| **CO2** | Realize how data is collected, managed and stored for data science |
| **CO3** | Apply various machine learning techniques in real-world applications |
| **CO4** | Implement data collection and management |
| **CO5** | Apply visualization tools for data visualization |
| **CO6** | Possess the required knowledge and expertise to become a proficient data scientist |

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

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| **Course Title** | **AUGMENTED REALITY** | **Duration** | **3hrs** |
| **Course Code** | **19EC2039** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Augmented Reality. | | CO1 | R | 1 |
| 2. | List any two differences between AR and VR. | | CO1 | R | 1 |
| 3. | Identify a 3D model in virtual environment with an example. | | CO2 | U | 1 |
| 4. | Interpret a Marker-less AR with an example. | | CO2 | U | 1 |
| 5. | State the role of tracking in AR systems. | | CO3 | R | 1 |
| 6. | Differentiate marker AR from marker-less AR with an example. | | CO3 | An | 1 |
| 7. | Name any two interaction techniques used in AR. | | CO4 | R | 1 |
| 8. | Describe a special purpose input device. | | CO4 | U | 1 |
| 9. | Give examples of AR in digital entertainment. | | CO5 | U | 1 |
| 10. | Name any one AR software development toolkit. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain any three key applications of augmented reality. | | CO1 | An | 3 |
| 12. | Explain the hardware components required for 3D visualization. | | CO2 | An | 3 |
| 13. | Compare projection-based and super-imposition AR techniques. | | CO3 | An | 3 |
| 14. | Articulate two common interaction techniques in immersive environments. | | CO4 | A | 3 |
| 15. | Illustrate the AR that is used in the gaming industry. | | CO5 | A | 3 |
| 16. | State any one AR development tool with its features. | | 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 architecture of an AR system with a neat diagram. | CO1 | An | 8 |
|  | b. | Distinguish between AR and VR from a user experience perspective. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the process of creating and rendering a 3D model in VR, with a neat sketch. | CO2 | U | 6 |
|  | b. | Explain the various display technologies used in AR with an example. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the workflow of market-based tracking with its advantages. | CO3 | U | 8 |
|  | b. | Write the limitations of marker-less AR. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Explain the importance of haptic feedback in AR applications, and overview on user interaction techniques in immersive VR. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Evaluate AR-based applications in education and training. Describe the challenges in deploying AR applications. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the development pipeline for AR using Unity 3D and Vuforia and summarize its challenges in deploying AR applications. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Interpret the multimodal interface in AR environments with a neat sketch. | CO4 | A | 6 |
|  | b. | Write short notes on immersive environment design. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Justify the hardware and software choices of AR systems using Unity 3D and Vuforia for an educational museum exhibit. | CO6 | E | 6 |
|  | b. | Classify and explain the risks and mitigation techniques during AR deployments. | CO6 | An | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Compare the difference between augmented reality and virtual reality. |
| **CO2** | Articulate the 3D model in virtual environment. |
| **CO3** | Illustrate the visual modeling in both marker and marker-less. |
| **CO4** | Categorize the difference interactive techniques in AR and VR. |
| **CO5** | Apply in various application of digital entertainment. |
| **CO6** | Explore AR and VR model in software tools. |

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

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| **Course Code** | **19EC2040** | **Duration** | **3hrs** |
| **Course Title** | **INTERNET OF INTELLIGENT THINGS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the primary advantage of IoIT over the traditional IoT systems. | | CO1 | R | 1 |
| 2. | Identify a real-time example of a parental object relationship. | | CO1 | U | 1 |
| 3. | Interpret the role of pooling layers in a CNN architecture. | | CO2 | R | 1 |
| 4. | Classify the different learning approaches used in unsupervised learning. | | CO2 | A | 1 |
| 5. | Name the company that coined the term fog computing. | | CO3 | U | 1 |
| 6. | Choose the programming language commonly used in Raspberry Pi. | | CO3 | A | 1 |
| 7. | List the shell command used to create a directory in Linux. | | CO4 | U | 1 |
| 8. | Select the most suitable AWS service to store and manage large volumes IoT data. | | CO4 | R | 1 |
| 9. | Select the suitable sensor used in implementing a non-invasive BCI. | | CO6 | A | 1 |
| 10. | Identify one real-time application of IoIT used in Intelligent Hospitals. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Identify any three key characteristics of Pervasive Intelligent Robots. | | CO1 | U | 3 |
| 12. | Illustrate Reinforcement learning with an example. | | CO2 | An | 3 |
| 13. | Differentiate between Fog computing and Cloud computing. | | CO3 | U | 3 |
| 14. | Write short notes on GPIO pins in Raspberry Pi and their purpose. | | CO4 | A | 3 |
| 15. | Examine the importance of Intelligent Tiering in Amazon S3. | | CO5 | An | 3 |
| 16. | Explain the role of V2X communication in enhancing the safety and efficiency of autonomous vehicles. | | 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. |  | Illustrate with a neat block diagram the importance of the Internet of Intelligent Things (IoIT) in healthcare, emphasizing its role in patient monitoring and arrhythmia detection. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the concept of Social Internet of Things (SIoT) and relate how smart objects establish and manage relationships in such networks. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Differentiate GCNN from FCNN with suitable examples. | CO2 | U | 6 |
|  | b. | Discuss any two types of supervised learning with appropriate examples. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Interpret the architecture of Fog computing and illustrate how it helps in image classification. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the limitations of Cloud Computing in real-time surveillance systems and justify how Fog Computing enhances decision-making at the edge. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Justify the need for integrating Raspberry Pi and Arduino in IoT architecture for efficient data handling. | CO4 | A | 8 |
|  | b. | Interpret key specifications of Raspberry Pi processor. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Explain the architecture, components, and applications of a Smart Networked City with a neat block diagram. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design a simple scenario showing how a smart wheelchair can interact with smart home devices (e.g., opening doors, switching lights) to aid a user, and explain the workflow. | CO6 | C | 12 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the concepts of intelligent things |
| **CO2** | Articulate the structure of Neural Networks in IoT |
| **CO3** | Understand the need of FOG computing services |
| **CO4** | Design and build IoT systems using Raspberry Pi |
| **CO5** | Be able to demonstrate various prototypes |
| **CO6** | Examine various real time applications and case studies |

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

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| **Course Code** | **19EC2043** | **Duration** | **3hrs** |
| **Course Title** | **TESTING OF VLSI CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Differentiate the types of stuck-at fault with respect to its voltage levels. | | CO1 | U | 1 |
| 2. | State the difference between permanent faults and intermittent faults. | | CO1 | U | 1 |
| 3. | List the major steps of PODEM algorithm. | | CO2 | R | 1 |
| 4. | Define test patterns. | | CO2 | R | 1 |
| 5. | List the steps in serial fault simulation. | | CO3 | U | 1 |
| 6. | List one advantage and disadvantage of parallel fault simulation technique. | | CO3 | R | 1 |
| 7. | Define Controllability in DFT. | | CO4 | R | 1 |
| 8. | List any two DFT techniques. | | CO4 | R | 1 |
| 9. | Define LSSD and indicate the type of latch it is made up of. | | CO5 | R | 1 |
| 10. | State the purpose of LFSR in BIST. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate yield from reject rate. | | CO1 | An | 3 |
| 12. | Justify the statement “sequential circuit testing is difficult as compared to combinational circuit testing”. | | CO2 | E | 3 |
| 13. | Estimate the fault coverage for all the “01” test pattern in Fig 1.    **Fig 1** | | CO3 | An | 3 |
| 14. | Transform the given flip-flop in Fig 2 into scan flip-flop.    **Fig 2** | | CO4 | U | 3 |
| 15. | Sketch IEEE 1149.1 boundary scan architecture with necessary labeling. | | CO5 | A | 3 |
| 16. | Illustrate the “number of 1’s” technique to compress the CUT responses in BIST. | | 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. | Justify that testing cost decides the yield of a chip. | CO1 | E | 4 |
|  | b. | Explain the different types of testing performed during the VLSI chip development. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 18. | a. | Sketch the block diagram of the Combinational and Sequential circuit. | CO2 | A | 4 |
|  | b. | Determine the test pattern for the given combinational circuit in Fig 3, to detect the presence of fault using D-algorithm.    **Fig 3** | CO2 | A | 8 |
|  |  |  |  |  |  |
| 19. |  | Determine the faults detected by the input vector for the circuit given in Fig 4, using deductive fault simulation.    **Fig 4** | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Construct a single latch LSSD using SRL L1/L2\* and explain its operation. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss the operation of IEEE 1149.1 chip architecture with neat diagram. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Discuss various Ad Hoc design rules for improving testability with necessary block diagrams. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the operation, merits and demerits of full serial integrated and isolated serial scan and compare its key features. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Sketch the basic architecture of BIST. | CO6 | A | 4 |
|  | b. | Determine the signature using the given LFSR circuit in Fig 5 for the output response “010001101110”    **Fig 5** | CO6 | A | 8 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Develop models for detecting faults in circuits. |
| **CO2** | Choose relevant test generation algorithms to generate test patterns for logic circuits. |
| **CO3** | Evaluate the test coverage metrics in digital circuits using fault simulation techniques. |
| **CO4** | Apply design-for-testability techniques to enhance observability and controllability in digital circuits. |
| **CO5** | Develop scan-based digital systems using standard scan techniques to meet structured test requirements. |
| **CO6** | Evaluate the performance of BIST architectures for effective fault detection. |

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

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| **Course Code** | **20EC2002** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRONIC DEVICES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Mention the two carrier transportation mechanisms. | | CO1 | U | 1 |
| 2. | Write the charge neutrality condition for intrinsic semiconductor. | | CO1 | R | 1 |
| 3. | Recall the resistance of an ideal when it is forward-biased. | | CO2 | R | 1 |
| 4. | What is the reverse saturation current of the diode, if the temperature increases? | | CO2 | R | 1 |
| 5. | Why NPN transistors are preferred over PNP transistors? | | CO3 | U | 1 |
| 6. | In CE configuration, when the collector junction is reverse biased and emitter junction is forward biased, the operating region of the transistor is called as; | | CO3 | R | 1 |
| 7. | The maximum drain current occurs in JFET when VGS is equal to | | CO4 | U | 1 |
| 8. | The high input impedance of MOSFET is due to the use of: | | CO4 | R | 1 |
| 9. | Define Zener breakdown. | | CO5 | U | 1 |
| 10. | What is meant by quantum efficiency in photodiode? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate drift current and diffusion current. | | CO1 | An | 3 |
| 12. | Define the term transition capacitance CT of a PN diode. | | CO2 | U | 3 |
| 13. | Compare the static characteristics of CC and CB. | | CO3 | An | 3 |
| 14. | Draw the structure of an N-channel FET. | | CO4 | U | 3 |
| 15. | Write down the applications of Avalanche photo diode. | | CO5 | An | 3 |
| 16. | Describe the operation of DIAC with neat sketch. | | 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. | **Derive the Poisson and Continuity equations for a one-dimensional semiconductor.** | CO1 | U | 6 |
|  | b. | **Explain the energy band diagram of intrinsic and extrinsic semiconductors.** | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | With neat sketch explain the construction, operation and VI characteristics of PN junction diode. | CO2 | R | 6 |
|  | b. | The reverse saturation current of a silicon PN junction diode is 10μA. Infer the diode current for the forward bias voltage of 0.6V at 25 C | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the working of NPN transistor in CC configuration and describe its input and output characteristics. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | With a neat sketch explain the characteristics of the E-MOSFET configuration. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the working principle of UJT with neat diagram. | CO5 | A | 6 |
|  | b. | Discuss in detail the operation of Tunnel and Schottky barrier diode | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. |  | Derive the Ebers Moll equations of BJT and the key aspects in different operating regions of transistor. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Brief about solid state memories. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the construction, working and characteristics of SCR. | CO6 | R | 8 |
|  | b. | Explain the working principle of photo diode. | CO6 | A | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the flow of charge carriers in semiconductor and interpret the VI relations. |
| **CO2** | Understand the physical and functional properties of diode. |
| **CO3** | Compare the properties of different configurations of bipolar junction transistors. |
| **CO4** | Apply the semiconductor concepts to construct MOS devices. |
| **CO5** | Categorize the special semiconductor devices based on their applications. |
| **CO6** | Infer the knowledge of power devices and display devices |

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

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| **Course Code** | **20EC2003** | **Duration** | **3hrs** |
| **Course Title** | **SIGNALS AND SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | In digital communication, a data sequence is stored and later retrieved in reverse order. If the discrete-time signal is x[n], write the time-reversed version. | | CO1 | A | 1 |
| 2. | Sketch the signal δ(n-3). | | CO1 | A | 1 |
| 3. | In an audio mixing system, the output sound is obtained by combining the input signal with the system’s impulse response. Relate the mathematical operation that connects the input and output signals. | | CO2 | U | 1 |
| 4. | A video enhancement system predicts the next frame based on future frames already stored in memory. Identify the type of system in terms of causality. | | CO2 | U | 1 |
| 5. | Write the continuous-time Fourier transform expression. | | CO3 | A | 1 |
| 6. | List any two applications for continuous-time Fourier series. | | CO3 | R | 1 |
| 7. | State Sampling Theorem. | | CO4 | R | 1 |
| 8. | Write the condition for the existence of the Laplace Transform. | | CO4 | A | 1 |
| 9. | State the time reversal property of the Discrete-Time Fourier Transform (DTFT). | | CO5 | R | 1 |
| 10. | Define the term “Region of Convergence” in the Z-Transform. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Test whether the given signal is periodic or not. If the signal is periodic, calculate the fundamental period. x(t)=2cos(3πt) + 7cos(9t) | | CO1 | An | 3 |
| 12. | A music player applies a volume control to an audio signal x(t) such that the output is y(t)=3x(t). If two audio signals x1(t) and x2(t) are input simultaneously, determine whether the system satisfies linearity. | | CO2 | A | 3 |
| 13. | List Dirichlet’s conditions for the existence of the Fourier series. | | CO3 | R | 3 |
| 14. | Determine the initial and final values of the signal from its given Laplace transform. | | CO4 | A | 3 |
| 15. | Compute the inverse Discrete-Time Fourier transform of  X(ejω) =4+ 5e-jω - 4e-2jω - 2e-3jω | | CO5 | A | 3 |
| 16. | Compute the Z-transform and its ROC for the signal: . | | 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 continuous-time signal h(t) is shown in the figure below. Sketch and label the following signals.  a. h(t+3) b. c. h(-2t +1) d. 3h(4t) | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Determine whether the system y(n) =log10[x(n)] is causal/ non-causal, static/ dynamic, time-invariant/ time variant and linear/ non-linear. Justify your answers. | CO2 | A | 6 |
|  | b. | Compute the output response of the system for the given input signal and the impulse response | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain any four properties of the Continuous-Time Fourier Transform (CTFT) with relevant proof. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine the Laplace transform and its associated ROC for each of the following signals: x(t) = e-4tu(t) + e3tu(-t) | CO4 | A | 6 |
|  | b. | Determine the impulse response of the given system. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Compute the Fourier transform for the following signals  i.  ii.  iii.  iv. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | In a digital audio recorder, continuous audio signals are converted into discrete-time signals for further processing. Explain the various techniques of signal sampling. Illustrate the concept of sampling using an impulse sequence. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | In a digital audio processing system, the output signal is obtained by combining an input signal with a system response FOR IMPULSE. Construct the output y(n) by convolving the following two discrete-time sequences using graphical method: x(n)={1,−1,1,−1}, h(n)={2,−2} | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Using the long division method, determine the inverse Z-Transform of the given function for (i) ROC |Z| >1 and (ii) ROC |Z| < 1. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Apply different types of signals for mathematical modeling in various system analysis scenarios. |
| **CO2** | Analyze system properties to develop basic models that simulate real-world processes. |
| **CO3** | Implement continuous-time systems using Fourier series and Fourier transforms, and apply them in signal processing tasks. |
| **CO4** | Examine the sampling process and Laplace Transform for modeling continuous-time systems. |
| **CO5** | Demonstrate the discrete-time system representation using Fourier series and Fourier transforms for signal analysis. |
| **CO6** | Design discrete-time systems and perform frequency analysis using the Z-transform. |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20EC2009** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate the primary function of the axon in a neuron. | | CO1 | U | 1 |
| 2. | Identify the component in an artificial neuron that performs the functionally analogous role to a synapse in a biological neuron. | | CO1 | U | 1 |
| 3. | Give an example of a regression task. | | CO2 | U | 1 |
| 4. | Indicate the activation function used in the output neuron for a binary classification task. | | CO2 | U | 1 |
| 5. | Identify the class of problems that a single-layer perceptron is fundamentally incapable of solving. | | CO3 | U | 1 |
| 6. | Name the learning rule used in the training of the Hopfield Neural Network. | | CO3 | R | 1 |
| 7. | Define the generalized delta rule. | | CO4 | R | 1 |
| 8. | Indicate the loss function used in a multiclass classification task. | | CO4 | U | 1 |
| 9. | List any two types of network normalization. | | CO5 | R | 1 |
| 10. | A max-pooling layer with a 4×4 filter and a stride of 2 is applied to a 32×32 feature map. Calculate the output size. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write any three applications of an artificial neural network in the field of IoT. | | CO1 | A | 3 |
| 12. | Calculate the total number of parameters in a fully connected network with 3 input neurons, 4 hidden neurons, and 2 output neurons. | | CO2 | A | 3 |
| 13. | A perceptron has weights [0.8,0.4], inputs [1,3], and a bias of 0.5. The activation function is a step function that generates output = 1 if the net input is ≥ 0 and output=0 otherwise. Compute the output of the perceptron. | | CO3 | A | 3 |
| 14. | Explain the role of optimizers in a neural network. | | CO4 | U | 3 |
| 15. | Distinguish machine learning from deep learning. | | CO5 | An | 3 |
| 16. | An image of size 256 × 256 is passed through a Convolutional Neural Network (CNN) layer with a 5 × 5 filter, stride 1, and padding 2, followed by a 2 × 2 max-pooling layer with stride 2. Compute the final output size. | | 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 working of an AND gate using the McCulloch-Pitts model with proper architecture and algorithm. | CO1 | A | 8 |
|  | b. | Compare ‘Computers’ with ‘the Human Brain’. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 18. | a. | A deep learning model used for medical image analysis employs an artificial neuron to classify cell types. For one image sample, the neuron computes a net input z=2.5.   1. Determine the neuron’s output if it uses the tanh activation function. 2. Determine the neuron’s output if it uses the sigmoid activation function. 3. Determine the neuron’s output if it uses the ReLu activation function. 4. Determine the neuron’s output if it uses the binary step activation function. | CO2 | A | 8 |
|  | b. | Compare supervised learning with unsupervised learning. | CO2 | An | 4 |
|  |  |  |  |  |  |
| 19. |  | Explain the architecture and the step-by-step training algorithm of a Simple Perceptron Neural Network designed to classify a fruit as either an 'Apple' or a 'Banana' based on the applicant features such as its weight, length and colour index. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the application of a backpropagation neural network in predicting whether a patient has diabetes or not, including a neat architecture and a detailed training algorithm. The following features are the inputs for the classification task: Glucose concentration, BMI, Age, and Insulin level. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the architecture of a deep feedforward neural network suitable for binary classification and explain the steps of the Gradient Descent algorithm used to train it. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Apply the autoencoder model for data dimensionality reduction and reconstruction and explain the unique contributions of the encoder and decoder to this process. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Apply the Discrete Hopfield Network model to store the bipolar input vector [1 1 1 –1] (or) [1 1 1 0] in binary representation. Test the network’s recall capability when the input pattern has missing entries in the first and fourth components. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the operational methodology of a Convolutional Neural Network (CNN) architecture optimized for a 10-class image classification task. Explain the distinct roles of the Convolutional, Pooling, and Fully Connected layers in mapping raw pixel input to the final multiclass probability output. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Compare and comprehend the functioning of human brain and ANN. |
| **CO2** | Gain an understanding about training methodologies of neural networks. |
| **CO3** | Summarize the pros and cons of different single layer ANN. |
| **CO4** | Apply artificial neural networks for solving engineering problems. |
| **CO5** | Outline the basic concepts and applications of deep learning. |
| **CO6** | Make use of different Deep networks for real time applications. |

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

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| --- | --- | --- | --- |
| **Course Code** | **21EC2001** | **Duration** | **3hrs** |
| **Course Title** | **OBJECT ORIENTED PROGRAMMING IN C++** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | A logistics company wants to compute the sum and difference of shipment weights. Construct a basic C++ program structure to perform this. | | CO1 | A | 1 |
| 2. | In a real-time monitoring system, Identify the feature that allows formatted output of sensor values to the console. | | CO1 | U | 1 |
| 3. | Explain a scenario where default function arguments reduce coding effort in payroll calculation | | CO2 | U | 1 |
| 4. | Describe how inline functions can optimize frequent calculations in a stock trading application. | | CO2 | U | 1 |
| 5. | Define how a constructor that can initialize default settings for IoT devices in a smart home system. | | CO2 | U | 1 |
| 6. | Cite how multidimensional arrays can store seating arrangement in a reservation system. | | CO3 | U | 1 |
| 7. | In a 3D graphics engine, you want to add two objects using + operator. Choose the C++ feature that can be adopted. | | CO3 | U | 1 |
| 8. | In a payroll system, if a derived class Manager inherits from base class Employee, Identify the access specifier that allows only public details of Employee to be accessible. | | CO4 | U | 1 |
| 9. | In a ride-sharing application, different vehicle types have a common function calculateFare() but different implementations. Identify the C++ feature that can be applied. | | CO5 | U | 1 |
| 10. | A retail company stores daily sales data. Identify the stream class that is best for file input/output. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Construct a program to calculate sum and difference of two account balances entered by user. | | CO1 | A | 3 |
| 12. | Develop a C++ program using a loop, check stock levels of 10 products and print “Reorder Needed” if stock < 5. | | CO2 | A | 3 |
| 13. | Write a C++ program to store and display patient details (ID, Name, Age) using Classes and objects | | CO3 | A | 3 |
| 14. | Construct the C++ program for a base class Person with the data member name, a derived class Teacher with the data member subject, and a derived class Principal with the data member department. Write a code to access these data | | CO4 | A | 3 |
| 15. | Compare Virtual with Pure virtual functions. | | CO5 | An | 3 |
| 16. | Explain the concept of ‘File Pointers’ WITH AN EXAMPLE | | 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. | Construct a C++ program to input the heart rates of seven patients and determine how many have values above 100 bpm. | CO1 | A | 6 |
|  | b. | Discuss why correct choice of data types is critical in recording machine sensor values. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe how switch-case can be used to categorize shipments by delivery zones. | CO1 | U | 8 |
|  | b. | Compare the working principle of ‘while’ and ‘do-while’ loop. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Develop a class Account with functions to deposit and withdraw money and track balance. | CO2 | A | 6 |
|  | b. | Discuss the benefits of using arrays and classes together to manage patient records efficiently. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Design a C++ program to overload the -- operator for a class. | CO3 | A | 6 |
|  | b. | Compare public vs protected inheritance in controlling machine access in a factory. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. |  | Explain the use of virtual functions in vehicle fare calculations in ride-sharing apps. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Build a C++ program to save the names and grades of five students in a file grades.txt and read them back. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Write a C++ program to display the memory addresses and values of five product prices using pointers. | CO5 | A | 6 |
|  | b. | Write a C++ program to swap two machine temperature readings using pointer variables. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Construct a C++ program to define a structure Employee with members ID, Name, and Salary. Input details for three employees and display the information. | CO3 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Solve complex mathematical problems using operators in OOP. |
| **CO2** | Design object initialization methods using constructors. |
| **CO3** | Analyze object-oriented design features such as encapsulation and modularities in creating scalable and maintainable software systems. |
| **CO4** | Develop various inheritance models to solve intricate object- oriented design challenges in C++. |
| **CO5** | Evaluate exception-handling mechanisms to build fault- tolerant and reliable applications. |
| **CO6** | Develop disk file I/O operations using streams and file pointers. |

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

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| --- | --- | --- | --- |
| **Course Code** | **21EC2006** | **Duration** | **3hrs** |
| **Course Title** | **MATHEMATICS FOR SIGNAL ANALYSIS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the condition for a signal to be an odd signal. | | CO1 | R | 1 |
| 2. | Determine the eigen value for the following 2×2 matrix. | | CO1 | A | 1 |
| 3. | Calculate the number of samples in the output y[n] if input  x[n] = [2, 1, 0] and impulse response h[n] = [1, 2] | | CO2 | A | 1 |
| 4. | List the properties of convolution sum. | | CO2 | R | 1 |
| 5. | Determine the inverse Fourier transform for δ (ω). | | CO3 | A | 1 |
| 6. | Enumerate the conditions for existence of Fourier series. | | CO3 | R | 1 |
| 7. | Define Nyquist rate. | | CO4 | R | 1 |
| 8. | Express the time shifting property of Laplace transform. | | CO4 | R | 1 |
| 9. | Compute the Fourier transform of u | | CO5 | A | 1 |
| 10. | Indicate the ROC for a non-causal sequence x(n). | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Test whether the following signal is a periodic signal or not.  *x(t) = cos* | | CO1 | An | 3 |
| 12. | Analyze the linearity of the system *y(t) = x2(t).* | | CO2 | An | 3 |
| 13. | Examine the Fourier transform for the signal *x(t)=e -|t*| | | CO3 | An | 3 |
| 14. | Compute the final value of if | | CO4 | A | 3 |
| 15. | Estimate the spectral coefficients for *x(n) = cos (πn/4).* | | CO5 | U | 3 |
| 16. | Determine the Z transform and ROC of the following signal.  x(n) = {1,2,3,4,5}. | | 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 discrete time signal is defined as follows:    Sketch the following signals that are derived from *x(n)*. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Determine the response of the system with the input and impulse response . | CO2 | A | 6 |
|  | b. | Test the linearity and causality for the system . | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Consider a stable LTI system characterized by the differential equation  + 6+ = 2x(t). Apply Fourier transform and find  (i) the impulse response of the system.  (ii) the response of the system if x(t) = t. e -2t u(t). | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine the transfer function of the system using Laplace Transform when the output y(t)=e-t - 2e-2t + e-3t and input x(t) = e-0.5t | CO4 | A | 4 |
|  | b. | Explain the impulse train sampling with the effect of aliasing and necessary spectrum representations. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 21. |  | Consider a system . Determine the output of the system for the input *x(n)= (1/4) nu(n).* | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Test whether the following signals are energy signal or power signal by computing the total energy and average power.   1. x(t)=cos t 2. *x(n) =* | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | State and prove any five properties of Laplace transform. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Determine the z transform and ROC of *x(n) = anu(n) – bnu(-n-1).* | CO6 | A | 6 |
|  | b. | Determine the transfer function for the following discrete time system.  *y(n) - 0.75 y(n-1) + 0.25 y(n-2) = x(n) +0.5 x(n-1).* | CO6 | A | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze different types of matrices, signals for mathematical modelling |
| **CO2** | Realize the system properties to build basic model |
| **CO3** | Represent continuous time system using Fourier series and Fourier transform |
| **CO4** | Investigate the sampling process and Laplace Transform |
| **CO5** | Signify discrete time system using Fourier series and Fourier transform |
| **CO6** | Familiarize the frequency analysis of discrete time system using Z transform |

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

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| --- | --- | --- | --- |
| **Course Code** | **21EC2014** | **Duration** | **3hrs** |
| **Course Title** | **MICROPROCESSORS AND MICROCONTROLLERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate the size of stack pointer in 8085 microprocessors. | | CO1 | U | 1 |
| 2. | Determine the physical address in the 8086 microprocessors, if SS = 3230 H and SP = 2456 H. | | CO1 | A | 1 |
| 3. | Indicate the timer mode in the 8051microcontroller, which is used as 16-bit timer. | | CO2 | U | 1 |
| 4. | Write the size of internal ROM in 8051 microcontrollers. | | CO2 | R | 1 |
| 5. | Give an example of a logical instruction in the 8051 microcontrollers. | | CO3 | U | 1 |
| 6. | Identify the wrong instruction from the following program segment in 8051 microcontrollers.  MOV B, #45H  MOV A, 45 H  MOVX B, @DPTR | | CO3 | R | 1 |
| 7. | Determine the number of interrupts can be accessed when two 8259 interrupt controllers are cascaded. | | CO4 | A | 1 |
| 8. | Define compiler. | | CO4 | R | 1 |
| 9. | Name any two signals used in RS232 standard. | | CO5 | R | 1 |
| 10. | Calculate the number of steps required to complete a 270-degree rotation in a stepper motor, if the step angle is 2 degrees. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the interrupts in 8086 microprocessors. | | CO1 | R | 3 |
| 12. | Illustrate the Internal RAM structure of the 8051 microcontrollers. | | CO2 | U | 3 |
| 13. | Develop an assembly language program in 8051 microcontrollers, to multiply two 8-bit numbers. | | CO3 | A | 3 |
| 14. | Predict the control word in 8255 PPI, when Group A ports are connected to display and Group B ports are connected to Keyboard mode 0. | | CO4 | A | 3 |
| 15. | Calculate the analog voltage for the given digital input 10101000, and the reference voltage 8V of the DAC. | | CO5 | An | 3 |
| 16. | Develop a circuit to interface a LED with Port pin P1.0 of the 8051 microcontroller. | | 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 architecture of the 8086 microprocessor with block diagram and discuss the functions of each block. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Discuss the salient features of the ports in 8051 microcontrollers with a relevant diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Interpret the addressing modes of 8051 microcontroller with an example | CO3 | A | 8 |
|  | b. | Predict the content of the accumulator after the execution of the following instructions  MOV A ,#56H  MOV R0, # F2H  ANL A, R0  INC A | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the different modes of operation of 8253 timer with a block diagram. Also write the control word format. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the SPI protocol with master and slave configurations. | CO5 | U | 8 |
|  | b. | Explain the features of Bluetooth protocol. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Describe the importance of interfacing ADC with the microcontroller 8051. | CO4 | R | 6 |
|  | b. | Sketch the block diagram of 8259 Programmable interrupt controller. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate a system to interface an 8kB RAM with any microprocessor/microcontroller and write the address mapping. | CO1 | An | 9 |
|  | b. | List the importance of CAN bus | CO5 | R | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the interfacing of stepper motor with microprocessor/microcontroller and explain the working with a flowchart/program. | CO6 | An | 8 |
|  | b. | Sketch the circuit to interface an LCD with microcontroller. | CO6 | A | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the microprocessor architecture and its interfacing techniques. |
| **CO2** | Describe the architecture of 8051 controller. |
| **CO3** | Execute basic and advanced Assembly language and C programs. |
| **CO4** | Interface I/O devices with Microcontroller. |
| **CO5** | Describe various communication Interface. |
| **CO6** | Recognize the functionality of Microcontroller and its applications to solve real world engineering. |

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**END SEMESTER EXAMINATION – NOVEMBER / DECEMBER 2025**

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| --- | --- | --- | --- |
| **Course Code** | **21EC2021** | **Duration** | **3hrs** |
| **Course Title** | **MULTIMEDIA ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Which device is typically used to capture video? | | CO1 | R | 1 |
| 2. | Suggest a strategy to enhance real-time multimedia collaboration for a global team. | | CO1 | U | 1 |
| 3. | Identify the two key areas where 3D technologies are primarily applied. | | CO2 | U | 1 |
| 4. | State the need for compression in handling multimedia content. | | CO2 | R | 1 |
| 5. | In what way does video animation differ from full-motion video? | | CO3 | U | 1 |
| 6. | Name any two components of a digital camera. | | CO3 | R | 1 |
| 7. | List any two transport protocols applicable to multimedia systems. | | CO4 | R | 1 |
| 8. | What does ITU-T stand for in multimedia communications? | | CO4 | R | 1 |
| 9. | Tell the role of query languages in multimedia systems. | | CO5 | R | 1 |
| 10. | Give an application each of mixed reality in education and industry. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | How can latency be reduced in mobile multimedia communications? Brief it. | | CO1 | U | 3 |
| 12. | Differentiate between HDTV and UDTV by outlining their key features. | | CO2 | U | 3 |
| 13. | A 24-inch monitor displays at a resolution of 1920 × 1080 pixels, with screen dimensions measuring 20.9 inches in width and 11.8 inches in height. Calculate the horizontal and vertical dot pitch of the monitor. (Provide the formulas used) | | CO3 | A | 3 |
| 14. | Given a VoIP application scenario, select the appropriate transport protocol and justify your selection. | | CO4 | A | 3 |
| 15. | Point out the challenges in handling streaming image and video data in multimedia systems. | | CO5 | U | 3 |
| 16. | Provide a brief outline of the stages involved in 3D modeling. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)** | | | | | |
| 17. | a. | Summarize the core concepts underlying the various techniques used in multimedia information retrieval. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Enumerate the basic data elements for multimedia systems and discuss their significance. | CO2 | U | 6 |
|  | b. | With a clear diagram, explain the structure and operation of the IMA architectural framework. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Discuss in detail about the function of each component of the Microsoft Windows for Pen System. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | A company is developing a mobile app for video sharing. Analyze and select suitable audio, image, and video compression techniques to ensure high quality with minimal data usage. Justify your selection. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | With a diagram, discuss the components of a multimedia database architecture and outline the types of data and formats it handles. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Briefly review the multimedia data interface standards and their purpose. | CO2 | U | 6 |
|  | b. | Depict the commonly used standards for compression of multimedia objects. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | A tech company developed a new voice recognition system designed to transcribe spoken commands into text. During a test run, the system processed a dataset of 3000 spoken words. The system’s transcription results were analyzed and showed the following:   * Correctly recognized words: 2600 * Substituted words (words wrongly recognized as others): 200 * Deleted words (words the system failed to recognize): 100 * Inserted words (extra words added that were not spoken): 150   Using the given data, calculate each of the performance metrics to evaluate voice recognition systems. Show all formulas and steps clearly. Discuss how these metrics affect system performance and which error is most important to minimize in real-world use. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A multimedia firm is developing an interactive digital museum exhibit on the evolution of communication technology. Explore how multimedia authoring tools can integrate text, images, audio, and animations into an engaging experience. Discuss the types of authoring tools suitable for this project. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Identify and explore the characteristics of multimedia systems. |
| **CO2** | Discuss the concepts of multimedia databases and illustrate audio, video indexing and retrieval techniques. |
| **CO3** | Describe various multimedia data and their transmission characteristics, identify the suitable standard for multimedia communication. |
| **CO4** | Illustrate the concepts based on multimedia compression techniques and internet protocols. |
| **CO5** | Discuss the different insights of multimedia tools and their usage. |
| **CO6** | Apply various multimedia image and video processing technologies. |

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

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| **Course Code** | **21EC2023** | **Duration** | **3hrs** |
| **Course Title** | **CYBER SECURITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Galois Field in a number theory framework. | | CO1 | R | 1 |
| 2. | List any two properties of Prime numbers according to number theory. | | CO1 | R | 1 |
| 3. | List the parameters which are referred as the pillars of security. | | CO2 | R | 1 |
| 4. | Compare vulnerability with threat. | | CO2 | U | 1 |
| 5. | Explain the two simple insecure hash functions. | | CO3 | A | 1 |
| 6. | Explain the challenge-response type of authentication. | | CO3 | U | 1 |
| 7. | Define intellectual property crime. | | CO4 | R | 1 |
| 8. | Distinguish between white hat and black hat hackers. | | CO4 | U | 1 |
| 9. | Distinguish between passive attack and active attack. | | CO5 | U | 1 |
| 10. | Analyze the necessity for security policy. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Estimate the addition table for (mod 8). | | CO1 | E | 3 |
| 12. | Analyze the conflict between integrity and confidentiality in the realm of security. | | CO2 | An | 3 |
| 13. | Establish the difference between message digest and message authentication Code. | | CO3 | A | 3 |
| 14. | Define the terms – Phishing, Spoofing and Espionage. | | CO4 | R | 3 |
| 15. | Interpret an IP spoofing attack. | | CO5 | A | 3 |
| 16. | List the information to be analyzed for creating a security policy. | | 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 various levels of primality testing methods | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Analyze vulnerabilities, threats, and controls in the context of security. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Apply the concept of Hash Function for message authentication and digital signature. Explain the relative methodologies with suitable diagrams. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the classes of cybercrimes and their types with an example for each. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the levels of DoS attacks and assess the methodologies used to protect from DoS/DDoS attacks. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain AES encryption algorithm with suitable diagrams. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the details of DES encryption algorithm with suitable diagrams. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Examine the stages of security policy development lifecycle and explain the steps in writing IT security policies. | CO6 | A | 12 |
|  |  |  |  |  |  |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply key concepts of number theory and analyze their implications in cryptography. |
| **CO2** | Analyze the various types of cryptographic techniques and ciphers for secure communication. |
| **CO3** | Evaluate hash functions and their applications in ensuring data integrity and authenticity in secure communications. |
| **CO4** | Analyze the classification of cybercrimes and examine specific issues for security and society. |
| **CO5** | Evaluate various cyber threats, types and techniques of identity theft to analyze their impact on individuals and organizations. |
| **CO6** | Develop comprehensive security policies and implement compliance and enforcement mechanisms for organizational security requirements. |

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

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| **Course Code** | **21EC2024** | **Duration** | **3hrs** |
| **Course Title** | **CLOUD AND DISTRIBUTED COMPUTING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define computing. | | CO1 | R | 1 |
| 2. | Describe the significance of utility computing. | | CO1 | U | 1 |
| 3. | List the features of cloud computing. | | CO2 | R | 1 |
| 4. | Define Public Cloud deployment model. | | CO2 | R | 1 |
| 5. | Identify the component that manages multiple virtual machines. | | CO3 | R | 1 |
| 6. | Define Desktop Virtualization. | | CO3 | R | 1 |
| 7. | List any two cloud service providers. | | CO4 | R | 1 |
| 8. | Interpret the significance of elastic load balancers. | | CO4 | A | 1 |
| 9. | List the layers present in the cloud layered architecture. | | CO5 | R | 1 |
| 10. | Define edge computing. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the concept of Utility Computing with examples. | | CO1 | A | 3 |
| 12. | Describe the taxonomy of Virtual Machines. | | CO2 | U | 3 |
| 13. | Infer the features of Geo distributed Clouds. | | CO3 | A | 3 |
| 14. | Analyze the differences between multi-tenant and single-tenant data centers. | | CO4 | An | 3 |
| 15. | Describe the features of open source cloud service tools. | | CO5 | U | 3 |
| 16. | Interpret the need for big data processing in cloud applications. | | 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 evolution of cloud computing and its significance in media streaming services with suitable example. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the significance of NIST Cloud Computing Reference Architecture in cloud service delivery with a neat diagram. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Infer the virtualization methods used in cloud computing and their impact on resource management. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | **Analyze** the role of open-source cloud service tools in modern cloud computing, including their benefits and challenges. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Examine the layered architecture of cloud computing with a neat diagram. | CO5 | A | 8 |
|  | b. | Describe the availability management metrics. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Appraise the features of cloud deployment models with examples. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | **Analyze** the cloud architecture focusing on the front-end, back-end, and network components. | CO5 | An | 8 |
|  | b. | Explain the components of the AAA framework in cloud security. | CO5 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the role of MapReduce and Spark in processing large-scale data in cloud environments. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the architecture, infrastructure and delivery models of cloud computing. |
| **CO2** | Design, implement and evaluate cloud-based systems, processes and components. |
| **CO3** | Implement the concepts of cloud storage, networks and management. |
| **CO4** | Use techniques, skills on cloud and distributed computing tools. |
| **CO5** | Develop an automated solution for cloud and distributed environment. |
| **CO6** | Apply the security models in the cloud. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 3 | 12 | - | - | 17 |
| **CO2** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO3** | 2 | - | 15 | - | - | - | 17 |
| **CO4** | 1 | - | 1 | 15 | - | - | 17 |
| **CO5** | 1 | 7 | 12 | 8 | - | - | 28 |
| **CO6** | 1 | - | 3 | 12 | - | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **21EC2035** | **Duration** | **3hrs** |
| **Course Title** | **DATA MINING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain the term Data Mining. | | CO1 | A | 1 |
| 2. | Name any two basic data mining tasks. | | CO1 | R | 1 |
| 3. | State the main objective of data preprocessing. | | CO2 | R | 1 |
| 4. | Define data cleaning | | CO2 | R | 1 |
| 5. | Explain association rule in data mining. | | CO3 | A | 1 |
| 6. | Define “support” in the context of association rule mining. | | CO3 | R | 1 |
| 7. | Describe classification in data mining. | | CO4 | R | 1 |
| 8. | Name the classifier based on Bayes’ theorem. | | CO4 | R | 1 |
| 9. | Name the most commonly used partitioning clustering algorithm | | CO5 | R | 1 |
| 10. | Identify one application of web mining. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the steps involved in the data mining process with a neat diagram. | | CO1 | An | 3 |
| 12. | Describe the various stages of data preprocessing. | | CO2 | R | 3 |
| 13. | Explain the working of the Apriori algorithm for association rule mining. | | CO3 | An | 3 |
| 14. | Explain the concept of Naïve Bayes classifier with an example. | | CO4 | A | 3 |
| 15. | Compare hierarchical clustering and K-means clustering methods. | | CO5 | E | 3 |
| 16. | Describe the process of text mining and its applications. | | 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. |  | Discuss the different data mining metrics used for evaluating the performance of data mining techniques with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain with suitable examples the processes of data cleaning, data integration, data reduction, and data transformation. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the FP-Growth algorithm. How does it overcome the limitations of the Apriori algorithm? Illustrate with an example. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Compare and contrast different classification techniques: rule-based classifiers, association-based classifiers, and nearest neighbour classifiers. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the different types of clustering methods (partitioning, hierarchical, density-based, and grid-based) with examples. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Discuss various similarity and distance measures used in clustering. Explain how they influence the clustering results. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Articulate the ethical and social implications of data mining. Explain with real-world examples how privacy and data misuse issues can arise in mining applications. | CO1 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate the role of data mining software tools (like Weka, RapidMiner, or Orange) in automating data preprocessing, model building, and result visualization. Provide a practical case study example. | CO6 | E | 12 |
|  |  |  |  |  |  |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the key areas and issues in data mining. |
| **CO2** | Understand the steps involved in data pre-processing techniques. |
| **CO3** | Summarize the theoretical and practical aspects of data mining algorithms. |
| **CO4** | Analyze and leverage data for real-time decision making. |
| **CO5** | Design the system to solve any real-application. |
| **CO6** | Determine whether a real-world problem has a data mining solution. |

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

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| **Course Code** | **22EC2001** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO BIG DATA** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define big data. | | CO1 | R | 1 |
| 2. | Give an example of structured data. | | CO1 | U | 1 |
| 3. | Identify the best NLP technique to instantly detect if a customer’s live chat message says: "I want to cancel my order immediately." | | CO2 | U | 1 |
| 4. | Give an example of stream processing platform. | | CO2 | U | 1 |
| 5. | Distinguish ‘database’ from ‘ file system’ | | CO3 | R | 1 |
| 6. | Give an example of relational database management system. | | CO3 | U | 1 |
| 7. | Name the Linux kernel feature used by the Local Resourse Shaper (LRS) Splitter to enforce the distinct priority tiers for CPU and I/O resource allocation. | | CO4 | R | 1 |
| 8. | Identify the specific component of the Hadoop ecosystem the enterprise must implement if it requires to access data stored in the cluster with real-time read and write access capabilities. | | CO4 | U | 1 |
| 9. | Identify the social network providing disaggregated spatial data. | | CO5 | U | 1 |
| 10. | Name a supervised machine learning classifier that can be used in sentiment analysis. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the types of qualitative data with examples. | | CO1 | U | 3 |
| 12. | Explain the explicit social link with an example. | | CO2 | U | 3 |
| 13. | Describe the key-value storage NoSQL database with an example. | | CO3 | U | 3 |
| 14. | Compare the Drop algorithm with the Drag algorithm used in the Big Data Replay architecture. | | CO4 | U | 3 |
| 15. | Explain Big Data aggregation's role in creating geospatial privacy risk. | | CO5 | U | 3 |
| 16. | Summarize the importance of feature engineering in sentiment 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. |  | Analyze the influence of the six key characteristics of Big Data (Volume, Velocity, Variety, Variability, Veracity, and Value) on the distinct analytical challenges and opportunities present in social media analytics and e-commerce decision-making. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the application of sentiment analysis on social media data related to a new movie release to classify the sentiments as positive, negative, or neutral. | CO2 | A | 8 |
|  | b. | Determine the outliers from the given data points using the Interquartile Range (IQR) method: Data = [13, 16, 14, 10, 45, 20, 22, 25, 40, 110] | CO2 | A | 4 |
|  |  |  |  |  |  |
| 19. |  | Explain the necessity of ACID properties in an e-commerce transaction system, focusing on their enforcement role in failed payment update management, resolution of concurrency issues during simultaneous purchasing, and the resulting performance trade-off when prioritizing transaction speed. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the mechanisms within the LRS Splitter and Interleave Scheduler that solve the low utilization and I/O bottleneck failures caused by traditional fair-share scheduling and static slot configuration in a MapReduce cluster. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the device-based sensing mechanism, its reliance on Big Data streams, and key limitations. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the content-based recommendation technique with a practical example. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | A financial institution deployed a new machine learning model to predict fraudulent credit card transactions (Positive Class). Over a test set of 10,000 transactions, the model's performance was recorded in the following confusion matrix:   |  |  |  | | --- | --- | --- | | **Actual Class** | **Predicted Positive (Fraud)** | **Predicted Negative (Normal)** | | **Actual Positive (Fraud)** | 120 | 30 | | **Actual Negative (Normal)** | 400 | 9,450 |   Using the provided data, calculate the following metrics,   1. Accuracy 2. Sensitivity 3. Specificity 4. Precision 5. False Positive Rate (FPR) 6. False Negative Rate (FNR) | CO1 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Examine a case study on Twitter(X) data correlation with weather and explain the methodology for collecting, preprocessing and analyzing the data using Big Data analytics. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic concepts of big data and its methods. |
| **CO2** | Analyze the real-time big data for social media applications. |
| **CO3** | Analyze data by its big data infrastructures and platforms. |
| **CO4** | Perform analytics on local resource consumption shaping and system optimization. |
| **CO5** | Understand the applications in big data security and privacy. |
| **CO6** | Comprehend the real data models and its applications. |

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

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| **Course Code** | **22EC2005** | **Duration** | **3hrs** |
| **Course Title** | **PATTERN RECOGNITION TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Describe classification in pattern recognition? | | CO1 | U | 1 |
| 2. | List any two approaches in pattern recognition. | | CO1 | R | 1 |
| 3. | List the types of discriminant functions. | | CO2 | R | 1 |
| 4. | What are the metrics can be used to measure the performance of a pattern recognition system? | | CO2 | R | 1 |
| 5. | Give an example of a binary classification problem in real life. | | CO3 | U | 1 |
| 6. | What is clustering in unsupervised learning? | | CO3 | R | 1 |
| 7. | How is parsing used in syntactic pattern recognition? | | CO4 | U | 1 |
| 8. | List any two types of graphs used in syntactic pattern recognition | | CO4 | R | 1 |
| 9. | Cite what is multilayer neural network | | CO5 | U | 1 |
| 10. | State how characters are classified in a pattern recognition system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Examine the role of training and learning in pattern recognition systems. | | CO1 | An | 3 |
| 12. | Compare supervised parametric and non-parametric learning approaches in PR systems. | | CO2 | An | 3 |
| 13. | Discuss the challenges of formulating unsupervised learning problems compared to supervised learning. | | CO3 | An | 3 |
| 14. | Outline the concept of how string matching is used in syntactic pattern recognition with a suitable example. | | CO4 | U | 3 |
| 15. | Draw the architecture showing the input layer, hidden layer(s), and output layer of a feedforward neural network used in pattern recognition. | | CO5 | An | 3 |
| 16. | Classify the roles of scene classification used in pattern recognition techniques. | | 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 importance of feature extraction in pattern recognition. Give examples of features used in image and text recognition. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Identify the significance of gaussian case and class dependence in classification. | CO2 | A | 6 |
|  | b. | Given a set of 1D data points for a class: x=[3,4,7,8], use Maximum Likelihood Estimation to find the mean and variance of the Gaussian model for this class. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Given the following 2D data points: (1,2), (2,3), (5,5), (6,6). Apply K-means clustering (k=2) and assign the points to clusters. Discuss how these clusters can be used for unsupervised classification. | CO3 | An | 10 |
|  | b. | List the issues of unsupervised learning. | CO3 | An | 2 |
|  |  |  |  |  |  |
| 20. |  | Discuss syntactic recognition using parsing techniques. Explain the use of formal grammars (such as context-free grammars) in representing patterns and how parsing algorithms identify and classify patterns. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the architecture of backpropagation network, training algorithm, including forward pass, error calculation, and weight update process. | CO5 | U | 8 |
|  | b. | Compare feedforward and feedback networks. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. |  | Explain the structure of pattern recognition system. Brief about the activities for designing the pattern recognition system with an example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Classify the different types of neural networks with architecture and explain the training process. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Recommend a best speech recognition technique to be used real time applications | CO6 | E | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic pattern recognition techniques |
| **CO2** | Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers |
| **CO3** | Realize the learning and clustering concepts. |
| **CO4** | Explain and compare a variety of pattern classification and structural pattern recognition |
| **CO5** | Identify and solve Engineering problems |
| **CO6** | Apply pattern recognition techniques to real-world problems such as document analysis and recognition |

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

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| **Course Code** | **22EC2009** | **Duration** | **3hrs** |
| **Course Title** | **BIO-INSPIRED OPTIMIZATION TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the need for optimization. | | CO1 | R | 1 |
| 2. | Interpret the concept of “survival of the fittest”. | | CO1 | U | 1 |
| 3. | Identify the process of creating new solutions by introducing random changes in genetic material of existing one in genetic algorithm. | | CO2 | R | 1 |
| 4. | Name the strategy that preserves the best solution so far and continues to influence the next generation. | | CO2 | R | 1 |
| 5. | Interpret the scenario when visual scope = 0 in artificial fish swarm optimization. | | CO3 | U | 1 |
| 6. | Explain in brief on the stigmergy concept used in Ant Colony Optimization | | CO3 | U | 1 |
| 7. | Identify the comparison used for solutions in dendritic cell optimization. | | CO4 | U | 1 |
| 8. | Compare the terms exploration and exploitation. | | CO4 | An | 1 |
| 9. | Describe brood parasitism. | | CO5 | U | 1 |
| 10. | Name two applications of bio-inspired optimization techniques. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List down few stopping criteria for an evolutionary algorithm | | CO1 | R | 3 |
| 12. | Compute the child for your pair P1 = 0010100110, P2 = 1001101001 using 2-point crossover at positions (2,8). | | CO2 | U | 3 |
| 13. | Infer the role of pheromones in ant colony optimization. | | CO3 | An | 3 |
| 14. | List the fundamental steps involved in spotted hyena optimization. | | CO4 | R | 3 |
| 15. | Infer the role of tumbling and swimming movement in Bacterial foraging optimization algorithm. | | CO5 | An | 3 |
| 16. | Predict the maximum achievable value of 0/1 Knapsack instance with a capacity of 10 and three items: Item1 (weight = 4, value = 12), Item2 (weight = 5, value = 10), Item3 (weight = 6, value = 17). | | 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 elements of a Bio-inspired optimization framework. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate different encoding schemes of Genetic algorithm with examples | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the working principle of Particle swarm optimization. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Interpret the hunting mechanism of Grey Wolf Optimization along with pseudocode. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Appraise the mathematical model of Firefly optimization algorithm | CO3 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the Fish swarm optimization based on their swimming behaviour. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Summarize on different optimization approaches. | CO1 | E | 6 |
|  | b. | Appraise the limitations of traditional optimization approaches. | CO1 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Develop a simple genetic algorithm to solve knapsack problem. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basics of problem solving through optimization. |
| **CO2** | Comprehend the working principle of each evolutionary method of optimization. |
| **CO3** | Assess the strength and weakness of each evolutionary optimization approach. |
| **CO4** | Analyze the optimization techniques based on genetic algorithm and swarm intelligence. |
| **CO5** | Explain the optimization techniques based on biogeography and natural ecology. |
| **CO6** | Apply evolutionary optimization to solve real world problems. |

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

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| **Course Code** | **22EC2013** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL SYSTEM DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Convert (10100110.10101)2 to equivalent hexadecimal number. | | CO1 | U | 1 |
| 2. | Identify the gate for the following truth table.   |  |  |  | | --- | --- | --- | | A | B | Y | | 0 | 0 | 0 | | 0 | 1 | 0 | | 1 | 0 | 0 | | 1 | 1 | 1 | | | CO1 | U | 1 |
| 3. | Observe the following circuit and write the Boolean expression | | CO2 | R | 1 |
| 4. | Identify the combinational circuit which always has n input and 2n output lines. | | CO2 | U | 1 |
| 5. | Convert the following binary code into gray code  (1010010) | | CO3 | U | 1 |
| 6. | Determine the number of flip flops required to design MOD- 8 counter. | | CO4 | A | 1 |
| 7. | In Up counter if the present state is 1100, predict the next state after applying clock pulse. | | CO4 | U | 1 |
| 8. | Define fan-in. | | CO5 | R | 1 |
| 9. | Identify the programmable logic devices that has programmable AND array and fixed OR array. | | CO5 | R | 1 |
| 10. | Identify the logic gate for the following verilog code.  module logic\_gate(a,y);  input a;  output y;  assign y = ~a;  endmodule | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch an OR gate using only NOR gates. | | CO1 | A | 3 |
| 12. | Determine the simplified logic expression for the given K-map. | | CO2 | A | 3 |
| 13. | Describe the output sum and carry equation of Half adder and draw the circuit diagram for the same | | CO3 | U | 3 |
| 14. | Compute the characteristic equation of JK flip flop. | | CO4 | A | 3 |
| 15. | Classify the different types of PLD based on their array structure. | | CO5 | U | 3 |
| 16. | Develop the Verilog code for 4X1 Multiplexer in any one modeling. | | 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. | For the following Boolean expressions construct the corresponding logic circuit, and determine the truth table.  Y= | CO1 | A | 6 |
|  | b. | Determine the canonical form (Sum of minterms) of the following logic expression.  Y=A’B+B’C’ | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Determine the simplified equation for the given expression using a K-map. | CO2 | A | 6 |
|  | b. | Construct a truth table and implement the following expression using NOR gates.  Y= A+(B.C) | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Construct the circuit diagram of 1X4 De-Multiplexer and write its truth table and output equation. | CO3 | A | 6 |
|  | b. | Explain the operation of Full Subtractor with a neat diagram. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Construct 2 bit magnitude comparator circuit diagram with a truth table. | CO3 | A | 8 |
|  | b. | Sketch the diagram of 4 bit parallel adder. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 21. |  | Construct a MOD-4 synchronous counter using T flip-flops and illustrate it with a state diagram. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Construct the following logic expression using PROM.  F1(A,B,C)=(0,1,3,5,6) F2(X,Y,Z)=(0,1,3,7) | CO5 | A | 6 |
|  | b. | Illustrate the operation of a clocked SR flip-flop with a neat diagram. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the operation of a 2 -Input CMOS NAND gate with a neat diagram. | CO5 | A | 6 |
|  | b. | Determine the various output configurations in TTL logic and describe any one with neat diagram. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Construct the circuit of a SISO shift register and describe its operation using timing diagrams. | CO4 | A | 8 |
|  | b. | Compare the operation of a latch and a flip-flop with respect to triggering and data storage characteristics | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the various types of memory used in computer systems. | CO5 | U | 6 |
|  | b. | Analyze the following equation and implement using PLA  F1= ABC+ABC  F2= AB´C+A´B´C´ | CO5 | An | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the basic postulates of Boolean algebra, operation of logic gates and Verilog data types. |
| **CO2** | Design and distinguish various combinational logic circuits. |
| **CO3** | Design and compare various sequential logic circuits. |
| **CO4** | Design different types of synchronous counters. |
| **CO5** | Illustrate different logic families. |
| **CO6** | Classify memory devices and identify methods for implementation of logic circuits. |

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

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| **Course Code** | **22EC2016** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL COMMUNICATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State Hartley–Shannon law. | | CO1 | R | 1 |
| 2. | Give an example for a discrete memoryless source. | | CO1 | U | 1 |
| 3. | State Delta Modulation. | | CO2 | R | 1 |
| 4. | List the types of line codes. | | CO2 | R | 1 |
| 5. | Define Inter Symbol Interference (ISI). | | CO3 | R | 1 |
| 6. | Express the Nyquist’s criterion for distortionless transmission. | | CO3 | U | 1 |
| 7. | Define Phase Shift Keying (PSK). | | CO4 | R | 1 |
| 8. | Name the modulation type used in GSM systems. | | CO4 | R | 1 |
| 9. | Express the equation for channel capacity and bandwidth. | | CO5 | U | 1 |
| 10. | Define Pseudo Noise sequence. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Calculate the entropy of a binary source emitting ‘1’ with P = 0.6 and ‘0’ with P = 0.4. | | CO1 | A | 3 |
| 12. | Differentiate the differential pulse code modulation from delta modulation. | | CO2 | U | 3 |
| 13. | Explain the effect of pulse shaping on ISI using raised-cosine filtering. | | CO3 | An | 3 |
| 14. | Sketch the constellation diagram for 8-PSK modulation. | | CO4 | A | 3 |
| 15. | State any three properties of a linear block code. | | CO5 | R | 3 |
| 16. | Explain any two applications of spread-spectrum techniques | | 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 discrete memoryless source emits symbols A–E with probabilities 0.3, 0.25, 0.2, 0.15 and 0.1. Using Huffman code, find the average code-word length, efficiency. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the line-coded waveforms for the binary data sequence 1011001 using the following groups of line coding schemes:   1. Unipolar schemes: NRZ and RZ 2. Polar schemes: NRZ and RZ 3. Bipolar schemes: NRZ and RZ 4. Manchester coding   For each group, sketch the waveform with appropriate amplitude levels and bit durations, and compare their DC component, bandwidth requirement, and synchronization capability. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the matched filter response for a digital receiver. | CO3 | A | 6 |
|  | b. | Illustrate how matched filter maximizes the signal-to-noise ratio in the presence of additive white Gaussian noise. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the working principle of 16-QAM modulation with neat block diagram | CO4 | An | 7 |
|  | b. | Sketch the 16/32/64 symbols constellation diagram of QAM modulation | CO4 | A | 5 |
|  |  |  |  |  |  |
| 21. |  | Consider a (7,4) linear block code whose generator matrix is     1. Find all the code vectors and hamming weights. 2. Determine the error detecting and correcting capability. 3. Find the parity check matrix **H**. 4. Find the error if received code is (100011). | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Apply the Shannon–Fano coding algorithm to the message ensemble consisting of symbols [A, B, C, D, E, F, G] with corresponding probabilities [0.4, 0.2, 0.12, 0.08, 0.08, 0.08, 0.04] and determine the   1. Shannon–Fano code for these symbols 2. the average code-word length and 3. Coding efficiency. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Construct the waveform of the Minimum Shift Keying modulated signal corresponding to the given data sequence [ 1 1 1 0 0 0 1], showing the bit mapping and phase continuity. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With neat block diagram, explain the operation of a Frequency Hopping Spread Spectrum (FHSS) system. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Infer the basics of information theory and source coding techniques to determine the required data rate for a reliable communication over the channel. |
| **CO2** | Depict the performance of different baseband modulation techniques. |
| **CO3** | Acquire Knowledge on inter symbol interference and its solutions. |
| **CO4** | Design and simulate various passband modulation schemes. |
| **CO5** | Compare and resolve various error control coding techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels. |
| **CO6** | Discern various spreading techniques and its applications. |

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

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| **Course Code** | **22EC2018** | **Duration** | **3hrs** |
| **Course Title** | **SIGNAL PROCESSING AND ITS APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the number of zeros to be padded to perform circular convolution between 𝑥1(𝑛) and 𝑥2(𝑛). Length of 𝑥1(𝑛) 𝑖𝑠 5 and the length of 𝑥2(𝑛) 𝑖𝑠 3. | | CO1 | U | 1 |
| 2. | Define Nyquist rate. | | CO1 | R | 1 |
| 3. | Name the property that makes the 2-D DCT attractive for image coding. | | CO2 | R | 1 |
| 4. | Estimate the number of butterfly stages needed for a 16-point radix-2 DIT-FFT. | | CO2 | U | 1 |
| 5. | Interpret the magnitude response of Chebyshev type I and Chebyshev type II LPF. | | CO3 | U | 1 |
| 6. | Illustrate the IIR filter design technique that provides a one-to-one mapping of frequencies from analog to digital domains. | | CO3 | U | 1 |
| 7. | Describe the purpose of a window function in FIR filter design. | | CO4 | R | 1 |
| 8. | State Gibb’s phenomenon. | | CO4 | R | 1 |
| 9. | Express the Wiener-Hopf equation. | | CO5 | U | 1 |
| 10. | List the primary color models used in image processing. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Evaluate the circular convolution of the sequences x1(n) = {1,1,1,1} and x2(n) = {1,2,3,4}. | | CO1 | An | 3 |
| 12. | Sketch the radix-2 DIT-FFT butterfly diagram for N=4. | | CO2 | A | 3 |
| 13. | Distinguish analog filters from digital filters. | | CO3 | An | 3 |
| 14. | Justify the need for windowing techniques in FIR filter design. | | CO4 | E | 3 |
| 15. | Illustrate the steps involved in LMS adaptive algorithm. | | CO5 | U | 3 |
| 16. | Differentiate between 8-adjacency and m-adjacency in pixel relation. | | 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. | Apply overlap add method to perform sectioned convolution  for the given sequences, and **.** | CO1 | A | 8 |
|  | b. | A continuous-time signal bandlimited to 4 kHz is sampled and quantized. Establish a two-stage sample-rate converter to go from 16 kHz to 24 kHz. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. |  | Compute the 8-point DFT of x[n] = {5, 5, 5, 5, 5, 5, 5, 5} using radix-2 DIT-FFT, show the butterfly outputs per stage. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Estimate a Butterworth filter for the following specifications using the bilinear transformation technique. Assume T = 1 sec. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine a linear phase FIR digital filter’s coefficient for the given specifications using Hanning window of length N=7. | CO4 | A | 8 |
|  | b. | Show that FIR filter with h[n] = {1/4,1/2,3/4,1/2,1/4} is a linear phase filter and also draw the linear phase realization structure of the filter. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. |  | Explain the basic wiener filter theory in detail and state the steps of Least Mean Square algorithm. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Compute the DFT(Direct) and FFT of the 4-point sequence x(n) = {1,0,0,0}. | CO2 | A | 8 |
|  | b. | Develop the linear phase realization structure for the following system function.  H(z) = 0.5 + 0.3z-1 + z-2 + 0.25 z-3 + z-4 + 0.3z-5 +0.5z-6 | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Sketch the direct form-I and direct form – II realization for the LTI system | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the sharpening spatial filters in detail. | CO6 | A | 6 |
|  | b. | Summarize the speech spectrogram with an illustration. | CO6 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Define signals and system mathematically in discrete time domain. |
| **CO2** | Formulate the Discrete-Fourier Transform (DFT) and the FFT algorithms. |
| **CO3** | Explain the various transformations for digital IIR filter design procedures. |
| **CO4** | Design FIR digital filters for various applications. |
| **CO5** | Outline the concepts of adaptive filtering algorithms. |
| **CO6** | Make use of signal processing techniques for speech and image applications. |

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

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| **Course Code** | **22EC2027** | **Duration** | **3hrs** |
| **Course Title** | **BRAIN COMPUTER INTERFACE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name one semi-invasive BCI recording technique that involves cortical surface electrodes. | | CO1 | R | 1 |
| 2. | Explain the principle of Magnetoencephalography (MEG) | | CO1 | U | 1 |
| 3. | Define slow cortical potentials (SCPs). | | CO2 | R | 1 |
| 4. | List the different types of oscillatory potentials observed in an EEG waveform. | | CO2 | R | 1 |
| 5. | State the importance of data processing in a Brain–Computer Interface (BCI). | | CO3 | R | 1 |
| 6. | State an application of feature extraction using phase synchronization in EEG/BCI. | | CO3 | R | 1 |
| 7. | Name two machine learning classifiers commonly used in Brain-Computer Interface (BCI) systems. | | CO4 | R | 1 |
| 8. | Interpret the reason for using polynomial regression in Brain-Computer Interface systems. | | CO4 | A | 1 |
| 9. | State the challenges encountered in multiclass classification. | | CO5 | R | 1 |
| 10. | Interpret the significance of the BCILAB toolbox in facilitating EEG signal analysis and BCI research. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the impact of preprocessing on the reliability of EEG signals in BCI applications. | | CO1 | An | 3 |
| 12. | Explain the key characteristics of motor imagery as observed in EEG-based studies. | | CO2 | U | 3 |
| 13. | List the time-domain features used in Brain-Computer Interfaces (BCI) and provide a brief description of each. | | CO3 | R | 3 |
| 14. | Describe the significance of Graph Theoretical Analysis in BCI and neuroscience applications. | | CO4 | U | 3 |
| 15. | Explain the principle and working of a P300 mind speller in EEG-based BCI systems. | | CO5 | A | 3 |
| 16. | List the feature extraction algorithms implemented in BCILAB. | | 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. |  | Develop a general Brain Computer Interface network diagram that details the step-by-step signal flow. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the structural features of the human brain and assess their significance in neurological and cognitive processes. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the concept, characteristics, and measurement of movement-related potentials (MRPs). | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the steps involved in principal component analysis (PCA) for dimensionality reduction. | CO3 | U | 8 |
|  | b. | Evaluate the common sources of artifacts in EEG signals and discuss their impact on signal quality. | CO3 | E | 4 |
|  |  |  |  |  |  |
| 21. |  | Analyze the critical steps involved in building an AI/ML model for EEG-based BCI applications. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the structure and functioning of a perceptron model. | CO4 | A | 8 |
|  | b. | Distinguish a single-layer network from a multi-layer network in terms of structure and learning capability. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Explain a case study of an invasive BCI, outlining the entire workflow from recording neural signals to executing the intended task | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the BCILAB architecture, showing the four major layers and the functions of commonly used components in each layer. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Choose appropriate components to build Brain-Computer Interface (BCI) systems. |
| **CO2** | Use signal acquisition and processing techniques to assess signal activation patterns. |
| **CO3** | Select suitable feature extraction methods for signal analysis. |
| **CO4** | Develop machine learning algorithms to classify and interpret signals in BCI applications. |
| **CO5** | Design real-world applications of BCI systems across healthcare, communication, and control systems. |
| **CO6** | Develop BCI systems using the BCILAB toolbox for signal processing and model training. |

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

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| **Course Code** | **22EC3004** | **Duration** | **3hrs** |
| **Course Title** | **GRAPH THEORY AND APPLICATIONS** | **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. |  | Enumerate any four applications of Graph Theory with examples and graphs. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. | a. | Show that a simple graph with  vertices and  components can have utmost  edges. | CO2 | E | 6 |
| b. | Evaluate, , , fuse vertices  and  in , find  and  in the following graphs. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Show that a tree with  vertices has  edges. | CO3 | E | 6 |
|  | b. | List all possible spanning trees of the given graph. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 4. |  | Show that every planar graph can be 5-coloured. | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. |  | Estimate the maximum flow for the following network using Ford-Fulkerson algorithm. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. | a. | Prove that a connected planar graph with  vertices and  edges has regions. | CO4 | E | 6 |
|  | b. | Show with graphical representation that the complete graph of five vertices is non planar. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the shortest path between  and using Dijkstra’s algorithm. | CO5 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Write with apt examples the key graph problems in VLSI physical design. | CO6 | U | 10 |
|  | b. | Write in detail the relationship between graph classes in VLSI design. | CO6 | U | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic structure of graphs. |
| CO2 | Understand the concept of planar and dual graph. |
| CO3 | Relate graph theory concepts in solving problems. |
| CO4 | Understand the data structure concepts. |
| CO5 | Apply the appropriate algorithms to for Physical design. |
| CO6 | Apply an analytical approach for Physical design. |

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

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| **Course Code** | **22EC3005\_PHD** | **Duration** | **3hrs** |
| **Course Title** | **TESTING AND TESTABILITY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Construct a fault table to identify the test vectors for the faults α stuck-at-0 and β stuck-at-1 in the given circuit. | CO1 | C | 10 |
|  | b. | Estimate fault dominance collapsed ratio for the circuit given considering all possible stuck at faults. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Determine the test pattern for the given combinational circuit, to detect the presence of fault using D-algorithm. | CO2 | A | 14 |
|  | b. | Analyze the advantages and limitations of random testing. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 3. | a. | Analyze how fault lists are created in concurrent fault simulation, and evaluate the process of identifying potential faults at each node in a circuit. | CO3 | An | 10 |
|  | b. | Identify the faults detected by the input vector for the circuit given, using deductive fault simulation. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the limitations of **ad-hoc DFT techniques** in high-speed, low-power sequential designs. | CO4 | A | 10 |
|  | b. | Differentiate between Controllability and Observability. | CO4 | An | 2 |
|  | c. | Write the LSSD design rules and explain the advantages of LSSD techniques. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Apply the principles of STUMPS to design a fault detection mechanism for a sequential circuit. | CO5 | A | 15 |
|  | b. | Explain **transition count based ORA** and its limitations in multi-fault detection for low-power designs. | CO5 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Sketch the block diagram of the Combinational and Sequential Circuit. | CO2 | A | 4 |
|  | b. | Construct BILBO architecture and discuss its operation in circuit testing. | CO5 | C | 16 |
|  |  |  |  |  |  |
| 7. | a. | Explain the significance of stuck at fault in VLSI testing. | CO1 | A | 8 |
|  | b. | Discuss on **errors, faults, and failures** in VLSI circuits. Also, explain the fault classes with suitable diagrams. | CO1 | U | 12 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Justify the need for fault simulation techniques in VLSI testing. | CO3 | E | 6 |
|  | b. | Illustrate the parallel fault simulation and serial fault simulation for VLSI testing with suitable example. | CO3 | A | 10 |
|  | c. | List the limitations of single latch LSSD. | CO4 | R | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Formulate Built-In Self-Repair (BISR) techniques, design a repair mechanism for a faulty RAM module, including the steps and components involved in the process. | CO6 | C | 16 |
|  | b. | Indicate how a 0 to 1 transition fault occur in a memory cell with state diagram. | CO6 | U | 4 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the testing concepts and compute the knowledge of modeling of faults. |
| CO2 | Utilize the test generation algorithms for generating test vectors. |
| CO3 | Perform modal analysis for fault simulation techniques. |
| CO4 | Design and develop various architectures for DFT. |
| CO5 | Develop various BIST architecture. |
| CO6 | Develop algorithms for memory testing. |

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

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| **Course Code** | **22EC3005** | **Duration** | **3hrs** |
| **Course Title** | **TESTING AND TESTABILITY** | **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. | Examine all the faults in the following CMOS circuit (Fig.1) for the output function.  Z= (A+B) (C+D) .EF    Fi  Fig.1 | CO1 | A | 8 |
|  | b. | Construct a fault table to identify the test vectors for the faults α stuck-at-1 and β stuck-at-0 in the given circuit shown in Fig.2.  Fig.2 | CO1 | C | 8 |
|  |  |  |  |  |  |
| 2. | a. | **Determine** the test pattern for the combinational circuit shown in **Fig.3** to detect the presence of the indicated fault using the **D-algorithm.**  H:\FIG\fig2.bmp  Fig.3 | CO2 | A | 8 |
|  | b. | For the logic circuit shown in **Fig. 4**, determine **the test patterns** required to detect all **single-node faults** along the paths **x2–l–n–p–F** and **x3–n–p–F.**    X1  X2  X3  m  p  n  F  l  Fig.4 | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Apply **concurrent fault simulation** using **convergence** and **divergence techniques** with a suitable example. | CO3 | A | 8 |
|  | b. | Determine the faults detected by the input vector for the circuit given in Fig.5, using deductive fault simulation.    **Fig.5** | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. |  | Assess the inclusion of **test points** using **Ad hoc design techniques** in enhancing the **observability** and **controllability** of a **digital circuit.** | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. |  | Apply the principles of STUMPS to design a fault detection mechanism for a sequential circuit. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Explain how exhaustive and pseudorandom testing is used in Built-In Self-Test (BIST) for fault detection. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Determine the test pattern for the given combinational circuit in Fig.6, to detect the presence of fault α s-a-0 using D-algorithm.    **Fig.6** | CO2 | A | 10 |
|  | b. | Determine the number of faults in all basic logic gates using equivalence fault collapsing and also find the collapse ratio for the following circuit. (Fig.7)        **Fig.7** | CO1 | A | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Using Built-In Self-Repair (BISR) techniques, explain how you would design a repair mechanism for a faulty RAM module. | CO6 | A | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify the testing concepts and compute the knowledge of modeling of faults |
| CO2 | Utilize the test generation algorithms for generating test vectors |
| CO3 | Perform modal analysis for fault simulation techniques |
| CO4 | Design and develop various architectures for DFT |
| CO5 | Develop various BIST architecture |
| CO6 | Develop algorithms for memory testing |

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

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| **Course Code** | **22EC3007** | **Duration** | **3hrs** |
| **Course Title** | **RECONFIGURABLE COMPUTING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Design a reconfigurable computing hardware architecture using SRAM-based FPGA fabric for high-speed image processing. Illustrate how logic elements, interconnect structures, and configuration memory contribute to performance improvement. Justify your design decisions with respect to flexibility, latency, and area optimization. | CO1 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Compare and contrast fine-grained and coarse-grained reconfigurable architectures for embedded automotive control systems. Develop a hybrid architecture integrating both paradigms, explaining how your design enhances computational throughput and energy efficiency. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Develop a streaming data flow model for a reconfigurable system that performs real-time video compression. Explain how control mechanisms such as FSMD and instruction augmentation can be used to optimize latency and throughput. | CO3 | A | 10 |
|  | b. | Analyze the role of phased reconfiguration and data parallelism in enhancing the performance of multi-threaded FPGA applications. Propose an implementation strategy and justify how your approach achieves better scalability compared to static architectures. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Develop a data flow–based programming model for implementing a real-time traffic monitoring system on a reconfigurable platform. Explain how scheduling, instruction augmentation, and phased reconfiguration can be used to achieve optimal performance and resource utilization. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Design an OS-level runtime scheduling framework for a heterogeneous reconfigurable computing platform. Discuss how your scheduler handles dynamic task binding, resource allocation, and communication latency under varying workload conditions. | CO4 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Design a structural mapping approach for an FPGA-based digital signal processing system. Explain how LUT-based mapping and area-performance trade-offs influence overall system efficiency. | CO5 | C | 10 |
|  | b. | Evaluate the effectiveness of the Pathfinder algorithm for routing high-speed data paths in reconfigurable architectures. Propose modifications to handle congestion and timing closure in large-scale FPGA designs. | CO5 | E | 10 |
|  |  |  |  |  |  |
| 7. |  | Develop an efficient mapping and routing strategy for FPGA-based AI accelerators. Explain how your mapping algorithm handles timing constraints, area optimization, and signal integrity while using the Pathfinder algorithm principles. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Develop a runtime reconfiguration strategy for implementing adaptive filtering in FPGA-based wireless communication systems. Explain how configuration bitstreams can be optimized for minimal reconfiguration delay. | CO6 | E | 10 |
|  | b. | Design an FPGA implementation plan for a real-time image recognition accelerator, integrating fixed and floating-point arithmetic units. Discuss how bitstream management and dynamic reconfiguration enhance performance and adaptability. | CO6 | C | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Propose and implement a runtime reconfigurable FPGA-based architecture for autonomous vehicle perception. Describe your bitstream management strategy, configuration data handling, and arithmetic module optimization (fixed and floating point) to achieve real-time performance. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Define reconfigurable computing hardware |
| CO2 | Demonstrate  reconfigurable computing architectures and systems |
| CO3 | Construct reconfigurable processing fabric architectures |
| CO4 | Inspect the Operating System for Reconfigurable Computing |
| CO5 | Determine the mapping and routing for reconfigurable platforms |
| CO6 | Build the various logic in  reconfigurable architectures |

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

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| **Course Code** | **22EC3010** | **Duration** | **3hrs** |
| **Course Title** | **MACHINE LEARNING FOR ENGINEERS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Compare supervised, unsupervised, and reinforcement learning by explaining their characteristics and providing suitable real-time examples. | CO1 | E | 10 |
|  | b. | Explain the role of Support Vector Machines (SVM) in classification, highlighting the factors that make it effective compared to other ML models. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyze the differences between biological and artificial neurons and the mathematical model of an artificial neuron. | CO2 | An | 10 |
|  | b. | Summarize different ANN architectures along with their main characteristics and examples. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the training algorithm and architecture of Hopfield neural network. Include mathematical equations wherever necessary. | CO3 | A | 10 |
|  | b. | Illustrate the fundamental principles of Adaptive Resonance Theory (ART) neural network and describe the process leading to stable learning. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the operation of convolution layers in a CNN and their role in feature extraction. | CO4 | An | 10 |
|  | b. | Summarize the architectures of AlexNet, VGG, and ResNet along with their key innovations. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Compare LSTM and GRU models and describe the influence of their internal gating mechanisms on sequence learning. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain various activation functions and their suitability for different ANN applications. | CO2 | A | 10 |
|  | b. | Interpret the role of Generative Adversarial Networks (GANs) in data generation and the interaction between the generator and discriminator. | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Interpret the working principles of Linear Regression and Logistic Regression along with their applications. | CO1 | A | 10 |
|  | b. | Illustrate the process of training a ConvNet and the influence of hyper parameters on model accuracy. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate the architecture and training algorithm of back propagation neural network with neat diagrams. Support your answer with necessary mathematical equations. | CO3 | An | 15 |
|  | b. | Summarize the drawbacks of the back propagation neural network. | CO3 | U | 5 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss machine learning applications in remote sensing, highlighting their contributions to image interpretation and environmental monitoring. | CO6 | U | 10 |
|  | b. | Explain machine learning techniques used for disease diagnosis, emphasizing their significance in early detection and classification. | CO6 | A | 10 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Outline the basic principles of machine learning techniques |
| CO2 | Understand the technical operation of artificial neural networks |
| CO3 | Describe the various neural network architectures and algorithms |
| CO4 | Understand the basic concepts of deep convolutional methods |
| CO5 | Analyze various deep learning architectures and algorithms |
| CO6 | Explore the various engineering applications using ML techniques |

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

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| **Course Code** | **22EC3013** | **Duration** | **3hrs** |
| **Course Title** | **WIRELESS SENSOR NETWORKS AND IOT** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Apply the concept of Controller Area Network (CAN) communication by illustrating its architecture and explaining the function of each major block. | CO1 | A | 10 |
|  | b. | Explain the working principles of RS232 and SPI communication protocols used in embedded systems. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain various types of IoT development boards used for small-scale applications, highlighting their key features, advantages, and limitations. | CO2 | A | 10 |
|  | b. | Analyze the major selection factors for an IoT development board in large-scale commercial systems and explain how these factors differ from choices made for small-scale or prototype-level IoT applications. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the sensor node architecture for IoT and its role in a WSN system. | CO3 | A | 10 |
|  | b. | Describe the role of the antenna in WSN transceiver design. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the architecture of SMAC-BMAC traffic - adaptive medium access protocol. | CO4 | A | 10 |
|  | b. | **Analyze the key differences between contention-based protocols and schedule-based protocols in terms of channel access, collision handling, delay, and energy efficiency. Support your answer with examples.** | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Describe the principle of WSN gateway concepts with the help of an architecture | CO5 | U | 10 |
|  | b. | Explain WSN tunneling with the help of diagram | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain various data gathering scenarios in sensor networks with examples | CO5 | A | 10 |
|  | b. | Analyze the process of data dissemination in wireless sensor networks by describing how data is propagated, stored, and forwarded among sensor nodes, and discuss the factors that influence dissemination efficiency. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate the architectural design of IPv4 versus IPv6 by drawing and annotating both protocol headers. Discuss at least three major differences and justify why IPv6 introduces these modifications to overcome IPv4 limitations. | CO6 | E | 10 |
|  | b. | Apply the concepts of circuit switching and packet switching to an IP-based Wireless Sensor Network (WSN) and explain how they differ in data transmission, delay handling, and resource usage. | CO6 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the architecture of 6LOWPAN based WSN | CO6 | A | 10 |
|  | b. | Describe the structure of tiny OS for IOT | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain Machine-to-Machine (M2M) communication and its significance in the Internet of Things (IoT) with the help of diagram. | CO6 | A | 10 |
|  | b. | Evaluate the architecture of the AllJoyn IoT networking framework by presenting a detailed block diagram, and explain how its components enable secure device discovery, session management, and communication. | CO6 | E | 10 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Interpret the behaviour of mobile and hoc network and correlate with the infrastructure-based networks. |
| CO2 | Infer and develop hardware-based set-up for the required IoT applications. |
| CO3 | Interpret the routing protocols and their implications on data transmission delay and bandwidth. |
| CO4 | Design networks with an attempt to reduce issue of broadcast and flooding techniques. |
| CO5 | Develop algorithms to improve existing or new wireless sensor network applications. |
| CO6 | Identify different protocol, design requirements, algorithms to meet the industrial requirement. |

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

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| **Course Code** | **MACHINE LEARNING** | **Duration** | **3hrs** |
| **Course Title** | **23EC2005** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define overfitting in machine learning. | | CO1 | R | 1 |
| 2. | List the advantages of supervised learning methods. | | CO1 | R | 1 |
| 3. | Distinguish between joint probability and conditional probability. | | CO2 | U | 1 |
| 4. | “Continuous probability distribution is used for sampling process in audio signals”. Justify this statement. | | CO2 | An | 1 |
| 5. | “Bi-level classification is accurate than multi-level classification”. Justify this statement. | | CO3 | An | 1 |
| 6. | List the different types of distance measures used in KNN classifier. | | CO3 | R | 1 |
| 7. | Distinguish between regression and classification. | | CO4 | U | 1 |
| 8. | “Logistic regression is used for classification than regression”. Justify this statement. | | CO4 | An | 1 |
| 9. | Summarize the significance of subtractive clustering in machine learning. | | CO5 | U | 1 |
| 10. | Describe the process of brain image classification with a neat diagram. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between under fitting and overfitting in machine learning. | | CO1 | An | 3 |
| 12. | The number of correctly classified images of “dog” category and “cat” category is 50 and 100 respectively. Compute the accuracy of the model tested with 200 images. | | CO2 | A | 3 |
| 13. | Summarize the significance of “support vectors” in SVM with illustration. | | CO3 | U | 3 |
| 14. | Distinguish between polynomial regression and linear regression. | | CO4 | An | 3 |
| 15. | Distinguish between membership values and centroids in FCM algorithm. | | CO5 | An | 3 |
| 16. | “Feature selection is used to reduce the complexity of the data classification process”. Justify this statement. | | 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. | Distinguish between supervised and unsupervised machine learning methods. | CO1 | An | 6 |
|  | b. | A company developed a ML model to classify mails as “spam” and “not spam”. They tested the model on 200 mails and the confusion matrix is given below:   |  | **Predicted: Spam** | **Predicted: Not Spam** | | --- | --- | --- | | **Actual: Spam** | 70 | 10 | | **Actual: Not Spam** | 30 | 90 | | Compute: Accuracy, | Precision and Recall | for the given model. | | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Summarize the characteristic features of discrete and continuous probability distributions with relevant illustrations. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | A dataset was collected to build a spam classifier. Each email is classified as **Spam** or **Not Spam** based on certain keywords. The model uses two features:   * **"Offer"** – whether the word "offer" appears in the email. * **"Win"** – whether the word "win" appears in the email.  | **Email ID** | **Offer** | **Win** | **Class** | | --- | --- | --- | --- | | 1 | Yes | Yes | Spam | | 2 | Yes | Yes | Spam | | 3 | Yes | No | Spam | | 4 | No | Yes | Not Spam | | 5 | No | No | Not Spam | | 6 | No | No | Not Spam |   Using Naive Bayes algorithm, determine the category (spam/not spam) of a new email with: **Offer = Yes, Win = Yes** | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Distinguish between linear regression and logistic regression. Augment your answer with the process of converting linear into logistic regression. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | “Fuzzy C-means clustering is accurate than the K-means clustering method”. Justify this statement with the algorithms of these centroid-based methods. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain a 3-class classification process for plant disease classification using SVM classifier. | CO6 | C | 6 |
|  | b. | Explain a regression model for weather prediction using linear regression. | CO6 | C | 6 |
|  |  |  |  |  |  |
| 23. |  | Summarize the significant features of k-NN classifier in bi-level classification. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the different scenarios of support vector selection in SVM classification. | CO4 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Interpret the pros and cons of supervised and unsupervised machine learning algorithms. |
| **CO2** | Evaluate the performance of regression and classification algorithms using accuracy measures. |
| **CO3** | Evaluate the performance of decision tree models using LMS algorithms. |
| **CO4** | Evaluate the performance of Support Vector Machines using maximum margin methods. |
| **CO5** | Evaluate the performance of clustering algorithms using centroid and density approaches. |
| **CO6** | Develop machine learning models for pattern recognition applications. |

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

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| **Course Code** | **23EC2011** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL IMAGE PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Compute the city block distance between the two pixel coordinates p(11,3) and  s(7,5). | | CO1 | A | 1 |
| 2. | If a grayscale image has a resolution of 800 x 600 pixels, and each pixel requires 1 byte for intensity information, Calculate the number of bytes needed to store the entire grayscale image. | | CO1 | A | 1 |
| 3. | Define gray level slicing. | | CO2 | R | 1 |
| 4. | List any two spatial sharpening filters. | | CO2 | R | 1 |
| 5. | Define the CMYK color space. | | CO3 | R | 1 |
| 6. | Define Chromaticity. | | CO3 | R | 1 |
| 7. | List the shapes of structuring element in morphological image processing. | | CO4 | R | 1 |
| 8. | State the key properties of dilation in morphological image processing. | | CO4 | R | 1 |
| 9. | Define region growing. | | CO5 | R | 1 |
| 10. | Define radiometric correction. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compute the resultant images of logical addition and logical multiplication for the following binary images used in a game development scenario to manipulate images for visual effects:  Image A: Image B:  0 0 1 0 1 0  0 1 0 1 1 1  1 1 0 0 1 1 | | CO1 | A | 3 |
| 12. | Explain the intensity transformation techniques. | | CO2 | U | 3 |
| 13. | List the significance of the HSI color model. | | CO3 | R | 3 |
| 14. | In an industrial quality control application, consider a binary image of a manufactured component represented as:  Input Image: 1 1 0 1 1 1 1 1 1 0  Structuring Element: 1 0 1  Determine the output image after performing the erosion operation to detect structural defects. | | CO4 | A | 3 |
| 15. | Compare region splitting and region merging. | | CO5 | An | 3 |
| 16. | List the applications of digital image processing in the field of agriculture. | | 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 geometric transformations—translation, scaling, and rotation—used to position virtual objects in the real-world scene in an augmented reality application. | CO1 | A | 8 |
|  | b. | Explain the key stages in digital image processing. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain histogram processing techniques used to enhance contrast in medical images for better diagnosis. | CO2 | A | 8 |
|  | b. | Describe the operation of smoothing and sharpening spatial filters. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Explain color image sharpening in full color image processing for enhancing edges and fine details in digital photography applications. | CO3 | A | 8 |
|  | b. | Compute the HSI representation of the RGB color (128, 128, 128) used in a remote sensing application for land cover classification. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Explain the morphological algorithms for boundary extraction, hole filling, and connected component extraction to process an image effectively. | CO4 | A | 8 |
|  | b. | Differentiate between morphological opening and closing operations. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain the use of superpixel-based region segmentation to effectively segment roads, vehicles, pedestrians, and traffic signs in an autonomous driving system. | CO5 | A | 8 |
|  | b. | Describe the steps involved in the global thresholding algorithm for image segmentation. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. |  | A satellite imaging system captures a grayscale elevation map of a small region represented by the matrix A. Engineers use a structuring element B to perform grayscale dilation and erosion. Apply grayscale dilation and erosion on the given image A using the structuring element 𝐵 and show the resulting images. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the frequency domain filtering operation with a necessary block diagram. | CO2 | A | 8 |
|  | b. | Explain the concept of contrast stretching in digital image processing. | CO2 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the use of machine learning and image processing techniques in identifying abnormalities in medical images. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Summarize the foundational mathematical concepts underlying digital image processing techniques. |
| **CO2** | Differentiate between spatial filtering and frequency domain filtering methods, elucidating their respective principles and applications. |
| **CO3** | Apply the concepts of color image processing and gray image processing methods to real-world scenarios, demonstrating their practical relevance. |
| **CO4** | Utilize morphology-based tools to develop minor image processing solutions, analyzing their effectiveness in various contexts. |
| **CO5** | Critically evaluate and select appropriate image processing methods for segmentation applications |
| **CO6** | Create solutions to practical problems using image-processing concepts. |

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

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| **Course Code** | **23EC2013** | **Duration** | **3hrs** |
| **Course Title** | **MICROCONTROLLERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate the size of address bus in 8051 microcontrollers. | | CO1 | U | 1 |
| 2. | Examine the given instruction to identify the error and write the correct instruction. MOVX DPTR, A | | CO1 | A | 1 |
| 3. | List the numbers of I/O ports in 8051 microcontrollers. | | CO2 | U | 1 |
| 4. | Write the mode word in 8051 timers, when timer 0 is operating in mode1. | | CO2 | A | 1 |
| 5. | Choose the size of ALU in ARM7TDMI Processor. | | CO2 | A | 1 |
| 6. | Define pipelining | | CO3 | R | 1 |
| 7. | Giva an example of arithmetic instruction in ARM 7 processor. | | CO4 | U | 1 |
| 8. | Identify the interrupt which has the highest priority ARM7 processor. | | CO4 | R | 1 |
| 9. | State Hit in Cache Memory. | | CO6 | R | 1 |
| 10. | Indicate the number of GPIO pins in LPC 2148 | | CO1 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the given instructions and predict the data in Accumulator(A) after the execution.  MOV A, # 48H  XRL A, # 3FH | | CO1 | An | 3 |
| 12. | Determine the count value of 8051 timer for the delay of 2msec. | | CO1 | A | 3 |
| 13. | Differentiate between ARM State and Thumb State of ARM Processor. | | CO2 | An | 3 |
| 14. | Compare Big Endian and Little-Endian byte ordering system with an example. | | CO3 | U | 3 |
| 15. | Differentiate physical memory and virtual memory. | | CO6 | An | 3 |
| 16. | List the features of LPC 2148 | | CO2 | 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 different addressing modes of 8051microcontroller with an example. | CO1 | A | 8 |
|  | b. | Sketch the internal RAM structure of 8051 microcontroller. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Sketch the diagram to interface external 32 KB RAM with 8051 microcontroller and write the address mapping. | CO1 | A | 8 |
|  | b. | Illustrate the structure of any one as the modes in Timers of 8051 microcontrollers and explain its feature. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 19. |  | Write down the operating modes of ARM7 and explain each mode in  detail with necessary diagram. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate any two examples in the following group of instruction set of ARM processor.   1. Logical instruction 2. Shift instruction 3. Load /Store instruction | CO4 | U | 9 |
|  | b. | Predict the content of all the registers after the execution of the following instructions. if R0= 32H, R1= 89H, R2= 12H   1. SUB R0, R1, R2 2. ADD R0, R1, R2 | CO4 | A | 3 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail about the AMBA based Microcontroller with neat  block diagram | CO5 | U | 10 |
|  | b | Compare protected and unprotected system in Memory Management Unit (MMU) | CO5 | An | 2 |
|  |  |  |  |  |  |
| 22. | a. | List the alternate functions of PORT 3 in 8051 microcontrollers. | CO2 | R | 2 |
|  | b | Explain the following tools in the ARM development Kit.   1. ARM Assembler 2. Linker and Locator 3. Software Debugger (ARMsd) 4. Emulator (ARMulator) | CO4 | U | 10 |
|  |  |  |  |  |  |
| 23. | a. | Sketch the architexture of 8051 microcontroller and explain its features. | CO1 | A | 8 |
|  | b. | List the mapping techniques in cache memory. Explain any one detail. | CO5 | R | 4 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Develop the diagram to interface a unipolar stepper motor with LPC2148  ARM Controller and discuss in detail using Embedded C Program/flowchart. | CO6 | C | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Develop Programmes using 8051 Microcontroller Architecture |
| **CO2** | Interface Peripherals with 8051 Microcontrollers |
| **CO3** | Interpret ARM architecture types and their characteristics |
| **CO4** | Adapt ARM 7 instructions for Programming |
| **CO5** | Evaluate the need for memory management tools |
| **CO6** | Demonstrate programming skills for real-time applications |

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

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| **Course Code** | **23EC2019** | **Duration** | **3hrs** |
| **Course Title** | **ANTENNA THEORY AND WAVE PROPAGATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the fundamental parameters of an antenna. | | CO1 | R | 1 |
| 2. | Determine the directivity of an antenna with a beam solid angle of 0.2 sr. | | CO1 | A | 1 |
| 3. | Identify the near field and far field regions of an antenna. | | CO2 | R | 1 |
| 4. | Explain why a capacitive loading coil is used in short antennas. | | CO2 | U | 1 |
| 5. | Identify the antenna whose length is half the operating wavelength and resonates naturally without loading. | | CO3 | U | 1 |
| 6. | List the principle used to calculate the total radiation pattern of an array from individual element patterns. | | CO3 | R | 1 |
| 7. | Explain the basic idea behind Huygens’ principle in the context of antenna radiation. | | CO4 | U | 1 |
| 8. | A 3-element Yagi-Uda antenna has a driven element of length 0.5 λ. If the director elements are each 5% shorter than the driven element, tabulate the length of the director element. | | CO4 | A | 1 |
| 9. | Explain why MIMO antennas improve the data rate in wireless communication compared to a single antenna system. | | CO5 | U | 1 |
| 10. | Compare surface waves and space waves in terms of their propagation characteristics. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the physical concept of radiation mechanism in antennas. | | CO1 | U | 3 |
| 12. | A wearable device requires a compact antenna to operate at 2.4 GHz (Wi-Fi band). A straight wire dipole of length 0.03 m is designed.   1. Explain why this antenna does not naturally resonate at 2.4 GHz. 2. Identify a practical method to make it resonate in the wearable device. | | CO2 | An | 3 |
| 13. | A small wireless communication system uses a linear array of 4 isotropic antennas mounted on a base station, spaced equally along a line. Explain how uniform amplitude distribution and non-uniform amplitude distribution affect the side lobe levels in the radiation pattern. | | CO3 | An | 3 |
| 14. | Illustrate the radiation pattern of a parabolic reflector antenna. | | CO4 | U | 3 |
| 15. | Illustrate the key design considerations for wearable/implantable antennas. | | CO5 | An | 3 |
| 16. | Explain how ground reflection, refraction, and diffraction affect radio wave propagation. | | 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. |  | In a wireless communication lab, two antennas, Antenna 1 and Antenna 2, are placed in free space. Summarize the reciprocity theorem for antennas and derive it to show that the transmitting and receiving properties of both the elements are identical. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | A small circular loop antenna has a radius and carries a uniform current .   1. Solve the radiation resistance of the loop. 2. Identify the total radiated power. | CO2 | A | 6 |
|  | b. | Explain the magnetic vector potential for a half-wave dipole antenna from its current distribution. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the formation of the array factor, maxima directions, minima directions and half-power points for a uniform linear array of N isotropic point sources fed with equal amplitude and equal phase shift. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Apply the principles of antenna arrays to analyze the operation of a Yagi–Uda antenna, traditionally used for analog television reception. Explain its geometry, working mechanism, and radiation characteristics with relevant diagrams, and discuss its significance in modern communication systems. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Apply the principles of microstrip patch antennas to design a rectangular patch antenna suitable for Wi-Fi devices. Explain its geometry, feeding method, and resonant frequency calculation with diagrams. | CO5 | A | 6 |
|  | b. | Apply the concept of a reconfigurable antenna in modern communication systems. Explain its types, working principle, and applications with diagrams. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Analyze the operation of a Log-Periodic Dipole Array (LPDA). Explain its geometry, working principle, and frequency-independent characteristics with suitable diagrams. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Determine the directivity and gain of a short dipole antenna of length 0.1λ used in a wireless sensor system with 10 W input power and 85% efficiency. Also, analyze its effective aperture. | CO1 | E | 6 |
|  | b. | Apply the Friis transmission equation for a transmitting antenna of 50 W at 300 MHz, separated by 10 km from an isotropic receiving antenna. Calculate the received power and explain how mismatch in polarization affects the received signal. | CO1 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A communication engineer needs to establish a reliable HF link between two cities 1200 km apart. The link will use skywave propagation.   1. Estimate the type of waves suitable for this distance. 2. If the ionospheric F2 layer has a critical frequency of 6 MHz, estimate whether a 10 MHz signal can be used for this link. 3. Summarize the concepts of skip distance and maximum usable frequency (MUF) in the context of this link. | CO6 | E | 6 |
|  | b. | Calculate the maximum usable frequency (MUF) and skip distance for a signal reflected from the ionospheric F2 layer with , virtual height and takeoff angle . | CO6 | A | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Examine the antenna basic parameters. |
| **CO2** | Evaluate and analyze the relationship between fundamental concepts and field distributions in wire antennas. |
| **CO3** | Interpret the array factor for uniform and non-uniform arrays. |
| **CO4** | Assess and infer the field characteristics of special type antennas. |
| **CO5** | Analyze and design advanced microstrip patch antennas. |
| **CO6** | Differentiate radio wave propagation regions based on radiation characteristics. |

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

|  |  |  |  |
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| **Course Code** | **23EC2023** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRY 5.0** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the main energy source used during the First Industrial Revolution. | | CO1 | R | 1 |
| 2. | State one major technological advancement introduced in Industry 3.0. | | CO1 | R | 1 |
| 3. | List the applications of augmented reality in smart manufacturing. | | CO2 | R | 1 |
| 4. | Write two significant benefits of the implementation of automation in the industry 5.0. | | CO2 | R | 1 |
| 5. | State the key function of sensors and actuators in smart industry. | | CO3 | R | 1 |
| 6. | Mention the key benefits of the cloud data storage that is integrated in industry. | | CO3 | R | 1 |
| 7. | Identify the main components of a Cyber-Physical System. | | CO6 | R | 1 |
| 8. | State one example of CPS used in the medical field. | | CO6 | R | 1 |
| 9. | Identify one core element of an advanced robotic system. | | CO5 | R | 1 |
| 10. | List one industry where digital twins are implemented. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Summarize the functional balance between human and machine intelligence. | | CO1 | U | 3 |
| 12. | Sketch the essentials of cloud computing. | | CO2 | U | 3 |
| 13. | Outline the significance and benefits of the role of humans in industry 5.0. | | CO3 | U | 3 |
| 14. | List the functions of the key components of the cyber physical systems. | | CO6 | U | 3 |
| 15. | Summarize the importance of safety in cobot–human interactions. | | CO5 | U | 3 |
| 16. | Outline how digital twins contribute to end-to-end product lifecycle management. | | 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. | Summarise the significant benefits of Industry 5.0. | CO1 | A | 6 |
|  | b. | Illustrate the impact of the Industry 5.0 in smart manufacturing. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Interpret the significance of the following technologies that are integrated in the Industry 5.0   1. Collaborative Robots (Cobots), (b) Artificial Intelligence (AI)   (c) Advanced Human-Machine Interfaces (HMIs) | CO1 | A | 6 |
|  | b. | Explain the integration of IoT & Industry 5.0 in the field of Medical Robots for the performance of precision surgery. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Outline the significance, benefits and applications of the following:   1. Human–Machine Collaboration 2. Customization & Personalization 3. Well-being & Safety by Design | CO2 | A | 6 |
|  | b. | Summarise five key applications of the augmented reality (AR) in smart manufacturing. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the principle, application and benefits of the IoT in the following:   1. Supply Chain Optimization 2. Safety & Compliance 3. Energy Management | CO2 | A | 6 |
|  | b. | Tabulate the of significant focus and application of the following used in Industry 5.0.   1. Perception Layer (b) Network Layer (c) Middleware Layer 2. Application Layer | CO2 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Examine the working principles and the applications of the following sensors:   1. Vibration (b) Thermal (c) Pressure/Flow (d) Optical (e) Environmental | CO3 | An | 6 |
|  | b. | Discriminate the significance and the applications of the following data analytics techniques:   1. Descriptive Analytics (b) Diagnostic Analytics (c) Predictive Analytics 2. Prescriptive Analytics: | CO3 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the concepts and applications of the following block chain elements:   1. Supply Chain Transparency 2. Secure Data Sharing 3. Smart Contracts | CO4 | An | 6 |
|  | b. | Experiment the impact and key benefits of the internet of things in smart manufacturing. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Select an architecture for an integrated robotic automation cell with a neat sketch. | CO5 | E | 6 |
|  | b. | Construct an integration plan for cobots in a hybrid production line with a neat sketch. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Formulate strategies to achieve zero-waste production ecosystems. | CO6 | E | 6 |
|  | b. | Justify the need for global standards to harmonize Industry 5.0 technologies. | CO6 | E | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify and describe the key technologies and components of Industry 5.0, such as IoT, AI, and automation. |
| **CO2** | Evaluate the implications of Industry 5.0 on human-machine collaboration |
| **CO3** | Assess the Internet of Things (IoT) and its applications in Industry 5.0 |
| **CO4** | Analyze AI and machine learning in the manufacturing processes. |
| **CO5** | Create advanced robotics and automation systems |
| **CO6** | Critically evaluate the security and privacy considerations in Industry 5.0 and apply cyber-physical systems (CPS) in manufacturing |

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

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| **Course Code** | **23EC2024** | **Duration** | **3hrs** |
| **Course Title** | **IC FABRICATION TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Analyze the properties of photoresists and conclude which precaution is most critical during their handling. | | CO1 | An | 1 |
| 2. | Determine the maximum allowed number of 0.5 micron or larger particles in a Class 10 cleanroom. | | CO1 | A | 1 |
| 3. | Compare the trade-offs between wet and dry oxidation for field oxide formation. | | CO2 | E | 1 |
| 4. | Predict the reason of hydrogen-related defects during wet oxidation process. | | CO2 | E | 1 |
| 5. | Distinguish the types of photolithography process implementation based on technology node. | | CO3 | An | 1 |
| 6. | Explain the step-by-step photolithography process to transfer a specific pattern onto a silicon wafer. | | CO3 | A | 1 |
| 7. | Infer the key advantages and applications of implementing Plasma Enhanced Chemical Vapor Deposition System. | | CO4 | An | 1 |
| 8. | Categorize the uses of thin solid films across various industries. | | CO4 | An | 1 |
| 9. | Evaluate the critical issues in implementing advanced metallization schemes during IC fabrication. | | CO5 | E | 1 |
| 10. | Classify the types of heat lamps and their effectiveness during Rapid  Thermal Processing (RTP). | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Design a sequence of steps for preparing a silicon wafer suitable for semiconductor fabrication. | | CO1 | C | 3 |
| 12. | Explain the trade-off between throughput and electrical integrity in choosing wet versus dry oxidation. | | CO2 | A | 3 |
| 13. | Classify the applications of Photolithography. | | CO3 | An | 3 |
| 14. | Illustrate the CVD mechanism with a neat schematic. | | CO4 | An | 3 |
| 15. | Evaluate the process flow of incorporating copper damascene interconnect in VLSI systems. | | CO5 | E | 3 |
| 16. | Criticize the effectiveness of Rapid Thermal Processing in overcoming limitations associated with conventional thermal techniques. | | 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. |  | Analyze the crystal growth and wafer slicing process with a sequential procedure. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Interpret the dry oxidation process with a neat schematic diagram and elaborate the technique with its features and applications. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Analyze the photolithography process with a neat schematic and classify the types of lithography process with its advantages. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Summarize the operation of Chemical Vapor Deposition (CVD) systems and distinguish the types of CVD based on various operating pressures. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the causes of metal interconnect failures and determine effective methods to mitigate them. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Evaluate multilevel metallization schemes in IC fabrication. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the steps involved in PMOS fabrication process. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Construct a Rapid Thermal Processing (RTP) system for annealing and elaborate the operation of various RTP techniques. | CO6 | C | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the environment required for IC fabrication. |
| **CO2** | Recognize the importance of oxidation in IC fabrication process. |
| **CO3** | Understand the process of lithography. |
| **CO4** | Select suitable deposition techniques based on their application. |
| **CO5** | Illustrate the deposition techniques in IC fabrication process. |
| **CO6** | Understand different etching techniques in IC fabrication. |

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

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| **Course Code** | **23EC2025** | **Duration** | **3hrs** |
| **Course Title** | **ELECTROMAGNETIC FIELDS AND WAVEGUIDES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the conditions for two vectors A and B to be perpendicular. | | CO1 | R | 1 |
| 2. | Determine the vector H = 3y4z2ax + 4x3z2ay + 3x2y2az is a solenoidal | | CO1 | A | 1 |
| 3. | Determine the permittivity of the medium. | | CO2 | A | 1 |
| 4. | Indicate the total charge distributed over a line or curve. | | CO2 | U | 1 |
| 5. | Evaluate the Lorentz force equation. | | CO3 | An | 1 |
| 6. | Define magnetic moment. | | CO3 | R | 1 |
| 7. | Write the condition of magnetic susceptibility. | | CO4 | A | 1 |
| 8. | Determine the energy stored in magnetic field. | | CO4 | A | 1 |
| 9. | Define depth of penetration. | | CO5 | R | 1 |
| 10. | List the different modes of EM waves. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Evaluate, where, S is the surface of the cube whose limits are x = 0 to 1, y = 0 to 1 and z = 0 to 1. | | CO1 | An | 3 |
| 12. | Explain Coulomb’s Law. | | CO2 | U | 3 |
| 13. | Differentiate between magnetic flux and magnetic flux density. | | CO3 | An | 3 |
| 14. | Write the self-inductance equation of Solenoid. | | CO3 | U | 3 |
| 15. | Classify the different types of Maxwell’s equations. | | CO4 | An | 3 |
| 16. | Differentiate between characteristic impedance and load impedance. | | CO5 | 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. | Illustrate the divergence theorem and prove that . | CO1 | U | 6 |
|  | b. | Analyze the condition of stokes theorem and justify. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the Gauss’s law and derive the electric flux equation with a necessary mathematical expression. | CO2 | R | 10 |
|  | b. | Explain any one of the applications in Gauss’s law. | CO2 | U | 2 |
|  |  |  |  |  |  |
| 19. |  | Determine the electric boundary conditions of rectangular and cylindrical box placed in two different medium. With a neat sketch. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine the Electric field intensity due to infinite conductor with neat sketch. | CO3 | A | 10 |
|  | b. | Analyze the equation of energy stored in inductor. | CO3 | An | 2 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the magnetic field intensity H due to infinitely long wire with neat sketch. | CO3 | An | 8 |
|  | b. | Illustrate the magnetic moment of the current loop with the suitable expression. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 22. |  | Examine the Maxwell’s equation I and III with justification. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Determine the Poynting vector with power flow equation. | CO4 | R | 10 |
|  | b. | Explain the concept of uniform plane waves. | CO4 | U | 2 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write short notes on impedance matching. | CO5 | R | 4 |
|  | b. | Explain the characteristics of Smith chart. | CO5 | U | 4 |
|  | c. | Determine the general equations of transmission lines. | CO5 | R | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate an ability to apply the co-ordinate systems and are familiar with the different vectors operators. |
| **CO2** | Apply the knowledge on the concepts of electric fields and magnetic fields. |
| **CO3** | Determine the electromagnetic induction with EM tools. |
| **CO4** | Evaluate the characteristics of electromagnetic waves in different medium. |
| **CO5** | Interpret the essentials of transmission lines and its characteristics. |
| **CO6** | Apply mode analysis of electromagnetic concepts and to design waveguide structures. |

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

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| **Course Code** | **23EC3002** | **Duration** | **3hrs** |
| **Course Title** | **MULTIPLE ACCESSTECHNIQUES IN 5G NETWORKS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the channel capacity of MIMO multiple input, multiple output systems in fading channels. | CO1 | A | 10 |
|  | b. | Examine the outage probability analysis for Rician fading channels. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the operating principles, key benefits, and practical limitations of Artificial-Noise-based Physical Layer Security (PLS) and beamforming-based PLS techniques in 5G wireless networks. Provide a comparative analysis of both methods in terms of secrecy capacity, implementation complexity, and suitability for massive MIMO and millimeter-wave (mm Wave) communication systems. | CO2 | A | 10 |
|  | b. | Discuss the concept of **Secrecy Capacity** and **Secrecy Outage Probability** in a **MIMO (Multiple Input Multiple Output)** wireless communication system. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the working principle of a Sparse Code Multiple Access (SCMA) system. Discuss its transmitter and receiver structure with a neat diagram. | CO3 | A | 10 |
|  | b. | Explain the working principles of **Power Domain NOMA** and **Code Domain NOMA** with a suitable diagram. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Sketch the Architecture of Intelligent Reflecting Surface (IRS) in 5G Networks and explain in detail | CO4 | A | 10 |
|  | b. | Evaluate the effectiveness of index modulation (IM) when integrated with intelligent reflecting surfaces (IRS). Explain how IM contributes to higher spectral and energy efficiency, and justify its suitability for next-generation wireless networks. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the **Single Carrier based Full Duplex (FD) System** and **OFDM based Full Duplex (FD) Systems** with neat diagrams. | CO5 | A | 10 |
|  | b. | Apply the concept of Full-Duplex MIMO communication to sketch and explain a functional block diagram of a base station equipped with \_Nt​ transmit antennas and\_Nr​ receive antennas. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Evaluate the architecture of an OFDM-based full-duplex transceiver by illustrating its block diagram and assessing the function of individual blocks. | CO5 | E | 10 |
|  | b. | Analyze the role of self-interference cancellation (SIC) in 5G full-duplex communication systems. Explain the challenges in mitigating self-interference and compare analog and digital SIC techniques with respect to complexity and performance. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate the operation of NOMA in allowing users to simultaneously access the same resource by assigning different power levels. For a total power the total power is Ptotal= .1W, calculate the BER trend qualitatively if P1=0.3 W and P2=0.7 W. Determine which user benefits from improved BER, justify mathematically or conceptually, and suggest one technique to mitigate the weaker user’s BER. | CO6 | E | 10 |
|  | b. | Apply the principles of Non-Orthogonal Multiple Access (NOMA) to a Li-Fi network and illustrate its block diagram. Explain the function of each block in enabling simultaneous data transmission to multiple users. | CO6 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the operation of NOMA within an integrated terrestrial–satellite network (ITSN) where a GEO satellite and terrestrial base station jointly serve multiple users. Present a schematic diagram of the system, labeling the satellite, TBS, and ground users. Highlight NOMA superposition coding and discuss its advantages in such hybrid networks. | CO6 | E | 10 |
|  | b. | Describe the applications and advantages of non-orthogonal multiple access (NOMA) | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Sketch the architecture of NOMA based Li Fi network and explain its functions. | CO6 | A | 10 |
|  | b. | Illustrate the concept of a NOMA-based integrated satellite network and discuss one key advantage it offers over conventional OMA-based satellite communication systems. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate wireless link performance and its trade-offs in a structured manner. |
| CO2 | Develop the physical layer security model for MIMO systems. |
| CO3 | Analyse various advanced NOMA techniques and their benefits in wireless communication systems. |
| CO4 | Solve the beamforming and phase shift matrix optimization problem. |
| CO5 | Develop OFDM based full duplex systems. |
| CO6 | Evaluate the system link performance of NOMA systems. |

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

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| **Course Code** | **24EC3001** | **Duration** | **3hrs** |
| **Course Title** | **CMOS VLSI 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. |  | Formulate the expression for threshold voltage starting from the flat band voltage, and analyze it. Also, derive and explain in detail the expression for channel length modulation. | CO1 | C | 16 |
|  |  |  |  |  |  |
| 2. | a. | Analyze the propagation delay using a first-order approach, and calculate the propagation delay of a 0.25 μm CMOS inverter with a supply voltage of 2.5V. The normalized on-resistances of the NMOS and PMOS transistors are 13 kΩ and 31 kΩ, respectively. Additionally, determine the (W/L) ratios of the transistors, which are 1.5 for the NMOS and 4.5 for the PMOS. | CO1 | An | 6 |
|  | b. | Explain the fabrication process of MOSFETs, providing a neat diagram and a step-by-step breakdown of each stage. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. |  | Design and derive the common source MOSFET amplifier with and without source resistance Rs with voltage gain and impedance parameters. | CO2 | C | 16 |
|  |  |  |  |  |  |
| 4. |  | Analyze the CMOS inverter design with derivation in all five regions of operation with noise margin. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 5. |  | Design the CMOS logic styles with truth table for verification for the following functions in Dynamic, C2MOS and Transmission Gate.Y = ((A.B)+C.D) and Y= (A+C).(B+D) | CO3 | C | 16 |
|  |  |  |  |  |  |
| 6. | a. | Explain in detail, with a neat diagram, the concept of clocked CMOS logic (C2MOS) and design a 3-input NAND gate using clocked CMOS (C2MOS) logic. | CO4 | A | 10 |
|  | b. | Explain the Pipelining concept Latch-NORA-CMOS. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 7. |  | Design the structure of a mirror adder and explain its working principle. | CO5 | C | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Design the structure logic of 4\*5 array multiplier and illustrate its function. [Assume First 4-bit:1101, Second 5-bit:10100] | CO6 | C | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Analyze MOS device functionality and the fabrication process for CMOS ICs |
| CO2 | Interpret the performance of a CMOS inverter and MOSFET characteristics. |
| CO3 | Measure delay analysis in dynamic CMOS logic |
| CO4 | Construct sequential CMOS logic circuits using clock skew-intensive methodology |
| CO5 | Evaluate and simulate various Arithmetic Logic Units (ALUs) based on CMOS design |
| CO6 | Design a variety of high-speed building blocks utilizing CMOS design principles |

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

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| **Course Code** | **24EC3002** | **Duration** | **3hrs** |
| **Course Title** | **SOLID STATE DEVICE MODELING AND SIMULATION** | **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. |  | Apply the principles of quantum mechanics to derive the two-dimensional (2D), three-dimensional (3D) density of states (DOS) function for electrons in the conduction band of a semiconductor. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 2. | a. | Explain the indirect band gap of semiconductors, along with the relevant equations. | CO1 | A | 8 |
|  | b. | Calculate the space charge width and electric field in a PN junction, considering a silicon junction at T = 300K with doping concentrations of Na=1016cm-3 and Nd=1015cm-3. | CO1 | E | 8 |
|  |  |  |  |  |  |
| 3. |  | Explain and derive the expressions for drift and diffusion currents in a semiconductor. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 4. |  | Apply Poisson’s equation to determine the depletion width and built-in potential for a silicon p–n junction under equilibrium conditions. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 5. |  | Evaluate the various electrical parameters of a MOSFET using its transfer and output characteristics. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Apply the Level-1 SPICE model equations to simulate the drain current (𝐼ᴅ) vs. drain–source voltage (𝑉ᴅ𝑠) characteristics of an nMOS transistor. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Explain the Drain-induced Barrier Lowering (DIBL) in short-channel MOSFETs using its energy band diagram. | CO6 | An | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Explain the impact of high-k and low-k dielectrics on gate leakage in short-channel transistors. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Construct extrinsic semiconductors with specific carrier concentrations and understand the band Structures of semiconductors. |
| CO2 | Apply the models of carrier transport mechanism in semiconductors |
| CO3 | Develop the PN junctions for given specifications |
| CO4 | Analyze the MOS capacitors |
| CO5 | Simulate the compact models of MOSFETs |
| CO6 | Construct UDSM transistors to mitigate the short channel effects |

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

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| **Course Code** | **24EC3003** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL DESIGN USING FPGA** | **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. | Design a combinational circuit that detects whether a 4-bit binary input represents an even number. Implement the circuit using basic gates and derive the simplified Boolean expression. | CO1 | A | 8 |
|  | b. | Explain static hazard with a combinational logic circuit and suggest modifications and implement in logic circuit to make it hazard-free. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. |  | Develop a structural Verilog model for a 4-bit ripple carry adder using full adders as submodules. Include testbench module for simulation. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Develop a Verilog code for a 4-bit magnitude comparator circuit using  behavioral modeling. | CO3 | A | 8 |
|  | b. | Compare blocking and non-blocking assignments in Verilog with examples. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | Develop a 4:1 MUX using bidirectional transmission gate switches. | CO4 | A | 8 |
|  | b. | Develop a Verilog code to model 2-input CMOS XOR gate using Switch-level modeling with nmos and pmos primitives. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Compare SRAM vs anti-fuse FPGA programming technologies. Highlight their impact on reconfigurability and power. | CO5 | An | 8 |
|  | b. | Explain the programming, storing and erasing technology of EPROM programming technology. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Design an asynchronous 3-bit down counter using JK flip-flops and explain with its timing diagram. | CO1 | A | 8 |
|  | b. | Design a serial-in parallel-out (SIPO) shift register using D flip-flops. Explain the shift operation with timing table. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 7. |  | Explain the role of ports and modules in Verilog HDL and list the shift and relational operators with necessary examples. | CO2 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Implement the given Boolean functions using PLA architecture. | CO6 | A | 10 |
|  | b. | Describe the internal architecture of the Altera MAX 7000 family emphasizing on LAB and macrocell internal organization. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Design Digital circuits. |
| CO2 | Design Digital circuits using Data Flow & Structural modeling and develop test bench. |
| CO3 | Design Combinational and sequential circuits using Behavioral modeling. |
| CO4 | Analyze switch level and design the gates using switches. |
| CO5 | Design Memory subsystem. |
| CO6 | Implement the digital circuits on PLD and FPGA. |

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

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| **Course Code** | **24EC3010** | **Duration** | **3hrs** |
| **Course Title** | **SYSTEM ON CHIP DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | **Evaluate** different processor architectures and recommend the most suitable one for a real-time SoC. | CO1 | E | 10 |
|  | b. | **Analyze** how memory hierarchy and addressing modes influence system performance in a SoC. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | **Critically evaluate** the effectiveness of VLIW architecture in achieving instruction-level parallelism compared to superscalar processors. | CO2 | An | 10 |
|  | b. | **Evaluate** the trade-offs involved in selecting a soft processor core for an SoC in terms of area, configurability, and performance. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | **Apply** the concept of cache write policies to determine when a “write-back” or “write-through” approach is more efficient. | CO3 | A | 10 |
|  | b. | **Apply** the concept of test benches to validate the functionality of a processor core in an SoC environment. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | **Analyze** the architectural differences between AMBA and CoreConnect bus standards used in SoC design. | CO4 | An | 10 |
|  | b. | **Analyze** how reconfigurable technologies enable hardware reuse and flexibility in SoC architectures. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the impact of SoC IP interfaces and infrastructure on the complexity of verification and validation processes | CO5 | An | 10 |
|  | b. | **Apply** the concept of IP integration to verify SoC interfaces using standard verification environments like UVM or SystemVerilog. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | **Analyze** the benefits and limitations of co-simulation techniques in embedded SoC development. | CO5 | An | 10 |
|  | b. | **Illustrate** with a block diagram the basic bus architecture used for communication between processor, memory, and peripherals in an SoC. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the use of scratchpad memory to enhance data access speed in embedded SoC systems. | CO3 | A | 10 |
|  | b. | **Illustrate** the working of a vector processor for performing arithmetic operations on large data sets. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the influence of Network-on-Chip (NoC) topology on latency, bandwidth, and power consumption in a multi-core SoC. | CO6 | An | 10 |
|  | b. | Illustrate the mapping of the AES encryption algorithm onto a Network-on-Chip (NoC) architecture for parallel data processing. | CO6 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | **Illustrate** with a neat block diagram the **basic architecture of a Network-on-Chip (NoC)** showing routers, links, and IP cores. | CO6 | A | 10 |
|  | b. | **Apply** the concept of **task partitioning** to assign **3D graphics pipeline stages** across multiple NoC nodes. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Formulate address complex issues in System on Chip (SoC) design from a comprehensive perspective |
| CO2 | Evaluate the performance of SoC-based designs by selecting and comparing various processors |
| CO3 | Apply SoC design methodologies to implement practical system designs |
| CO4 | Create interconnection structures for an SoC-based system design |
| CO5 | Assess SoC validation techniques for handling moderately complex systems. |
| CO6 | Analyze the issues related to System-on-Chip design and implementation. |

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

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| **Course Code** | **24EC3012** | **Duration** | **3hrs** |
| **Course Title** | **NANOSCALE DEVICES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Examine in detail the concept of the Leakage Minimization Technique for Nanoscale CMOS VLSI. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Evaluate and explain in detail how applying a positive gate voltage to an N-channel enhancement-mode MOSFET leads to the creation of a conducting channel, and evaluate the resulting current-voltage (I-V) characteristics across its different operating regions (cutoff, linear, and saturation). | CO2 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain in detail about Quantum confinement effects in a nanoscale multigate transistor for Energy subbands with a neat sketch. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the concept of Single-Electron Transistor (SET) logic circuits. Explain with a schematic diagram. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Analyse the techniques for energy-efficient designs in 5G and edge computing systems. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Infer in detail about the significance of low-power devices in wearable and biomedical applications. | CO2 | C | 20 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the techniques for energy-efficient designs in 5G and edge computing systems. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate the evolution and characteristics of low-dimensional semiconductor structures of quantum dots, and elaborate on the applications of Semiconducting Quantum Dots. | CO4 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Defend the Depiction of a spin valve with a neat schematic diagram and elaborate in detail on Spintronic Devices and Applications. | CO6 | E | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate  the leakage current  reduction techniques in CMOS devices. |
| CO2 | Analyze FinFETs and nanowire MOSFETs for low-power applications |
| CO3 | Analyze two-dimensional scaling in single and multi-gate MOSFETs. |
| CO4 | Develop low-power and voltage scaling strategies for nanoscale CMOS. |
| CO5 | Analyze heterostructure and nanowire-based devices for nanoelectronic applications. |
| CO6 | Apply spintronics, RTDs, and graphene-FETs in circuit design |

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

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| **Course Code** | **24EC3013** | **Duration** | **3hrs** |
| **Course Title** | **VLSI TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Apply the Deal–Grove oxidation model to calculate and analyze the oxide thickness growth for both dry and wet oxidation processes. Discuss how oxidation temperature and ambient type influence oxide integrity and device performance. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Using a step-by-step approach, apply the photolithography process to design a MOS transistor gate structure. Include mask alignment, photoresist patterning, and etching considerations to achieve desired line-width accuracy at the submicron level. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Apply the Deal–Grove model to determine the oxide thickness grown on a silicon wafer after a given oxidation time under both dry and wet oxidation conditions. Compare how oxidation temperature and ambient type affect the growth rate and oxide quality. | CO2 | A | 10 |
|  | b. | Analyse the concept of thermal oxidation kinetics, design an oxidation process schedule to achieve a specific gate oxide thickness suitable for CMOS transistors. Explain how you would control parameters such as temperature, pressure, and time to obtain uniform oxide layers across the wafer. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Design and explain a complete lithography and etching sequence for fabricating a MOSFET gate structure in a VLSI process. | CO3 | C | 20 |
|  |  |  |  |  |  |
| 5. |  | Apply Fick’s second law of diffusion to determine the dopant concentration profile after a specific diffusion time and temperature. Compare the resulting junction depth with that obtained using ion implantation followed by annealing. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Examine the principles of physical vapor deposition (PVD) to outline the steps involved in forming a thin aluminium interconnect layer on a silicon wafer. Explain how deposition parameters such as chamber pressure, substrate temperature, and deposition rate influence film uniformity and adhesion. | CO5 | A | 10 |
|  | b. | Using the understanding of electromigration and contact resistance, design a suitable interconnect material selection and layout strategy for high-performance CMOS circuits. Justify how your design ensures reliability and minimizes signal delay. | CO5 | E | 10 |
|  |  |  |  |  |  |
| 7. |  | Design a metallization scheme for a multi-level interconnect VLSI chip using aluminium and copper. Apply knowledge of deposition, adhesion, and electromigration effects to propose an optimized interconnect process ensuring long-term reliability. | CO5 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Apply the concept of VLSI process integration to design a complete CMOS technology flow for fabricating an inverter. Illustrate the key process steps such as isolation, gate formation, source/drain implantation, and metallization with suitable diagrams. | CO6 | A | 10 |
|  | b. | Analyse the integration challenges encountered while combining Bipolar and CMOS (BiCMOS) devices on a single chip. Evaluate the trade-offs between performance, process complexity, and power efficiency in such integrated processes. | CO6 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Apply the CMOS fabrication process flow to design a 2-input NAND gate at the layout level. Illustrate the sequence of oxidation, lithography, diffusion, and metallization steps necessary to achieve correct transistor operation and connectivity. | CO6 | A | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Design process flow for the fabrication of semiconductor devices |
| CO2 | Examine the oxidation techniques in fabrication process |
| CO3 | Demonstrate the lithographic fabrication process. |
| CO4 | Analyze the performance of various diffusion models. |
| CO5 | Evaluate the metallization techniques in VLSI technology. |
| CO6 | Apply the various IC technologies for chip design |

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

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| **Course Code** | **24EC3013** | **Duration** | **3hrs** |
| **Course Title** | **VLSI TECHNOLOGY** | **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. | Apply the principles of **EGS preparation** to explain how **MGS is obtained,** anddescribe the role of **trichlorosilane formation** and **CVD** in achieving high-purity silicon with equations. | CO1 | A | 8 |
|  | b. | Analyze the factors that influence **crucible material selection** in the Czochralski process. Discuss how parameters like melting point, thermal stability, hardness, chemical compatibility, and cost affect crystal quality and production efficiency. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. | a. | Analyze different oxidation techniques and systems used for silicon dioxide formation. Discuss their relative advantages, limitations, and suitability for VLSI applications. | CO2 | An | 8 |
|  | b. | Apply the Deal–Grove model to explain the kinetics of silicon dioxide growth for thin and thick oxide films, highlighting the growth rate changes with oxide thickness. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | **Examine how** plasma reactor design influences the etch rate and anisotropy in reactive plasma etching. | CO3 | A | 8 |
|  | b. | **Apply** the complete photolithography process sequence to transfer circuit patterns from the mask to a silicon wafer surface. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | **Analyze** atomic diffusion mechanisms such as interstitial, vacancy, and interstitial processes in crystalline and polycrystalline silicon | CO4 | An | 8 |
|  | b. | **Apply** Fick’s first and second laws of diffusion to determine impurity concentration profiles for constant source and limited source diffusion | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Apply the concept of metallization in the mechanism of hillock formation in aluminum contacts and ways to minimize it. | CO5 | A | 8 |
|  | b. | Analyze the problems in metallization considering processing challenges, metallurgical issues, and chemical reactions that affect device performance and reliability. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | **Apply** the sequence of reactive plasma etching steps to remove unwanted materials during device pattern transfer in MEMS or IC fabrication. | CO2 | A | 8 |
|  | b. | Determine the role of self-aligned silicide formation in reducing contact resistance in CMOS devices. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | **Apply** the principle of Physical Vapor Deposition (PVD) to deposit thin metallic films under high-vacuum conditions using a bell-jar system | CO2 | A | 8 |
|  | b. | **Apply** thermal oxidation techniques to form high-quality silicon dioxide layers on silicon substrates for MOS structures. | CO2 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Analyse the P-well fabrication process in CMOS technology and identify the steps that influence the electrical characteristics of the devices. | CO6 | An | 12 |
|  | b. | **Analyze** the sequence of wafer dicing, die picking, and packaging steps used in IC assembly lines. | CO6 | An | 8 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Design process flow for the fabrication of semiconductor devices. |
| CO2 | Examine the oxidation techniques in fabrication process. |
| CO3 | Demonstrate the lithographic fabrication process. |
| CO4 | Analyze the performance of various diffusion models. |
| CO5 | Evaluate the metallization techniques in VLSI technology. |
| CO6 | Apply the various IC technologies for chip design. |

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

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| **Course Code** | **25EC201** | **Duration** | **3hrs** |
| **Course Title** | **LINEAR ALGEBRA AND CALCULUS FOR ELECTRONICS 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 electrostatic energy in a 3-node capacitive network is given by *Express* this in matrix form. | 1c | R | 1 |
| 2. | The potential energy of an LC network is expressed in canonical form as . *Determine* the rank, index, and signature of the quadratic form. | 1d | R | 1 |
| 3. | In an electronic filter circuit, the frequency response is given by where is the input frequency in kHz. *Estimate* the frequency response at by simplifying the expression appropriately. | 2a | U | 2 |
| 4. | In radar signal processing, the amplitude modulation of a signal is given by where corresponds to envelope growth and represents carrier oscillations. *Determine* the instantaneous rate of change of the modulated signal. | 2b | U | 2 |
| 5. | The brightness of a 1D strip of an image is modeled by:  *Compute* the total brightness of the image strip. | 3a | U | 3 |
| 6. | *Formulate* the limits of integration to compute the total intensity of an image region bounded by , and . | 3b | U | 3 |
| 7. | The voltage in a tuned LC circuit is:. *Identify* the dynamic order and degree of the voltage response in the circuit. | 4a | R | 4 |
| 8. | A data signal in a 5 G system is modeled as.  *Identify* the roots of the auxiliary equation. | 4b | R | 4 |
| 9. | In an uniform electromagnetic wave field, the signal potential satisfies  where and . *Determine* the complete solution for the wavefront surface. | 5a | U | 5 |
| 10. | In a signal propagation surface, the potential function satisfies . *Compute* the complete integral. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | In the **state-space representation** of an RLC electrical network, the system matrix is defined as: This matrix characterizes the **dynamic relationship between voltage and current states** within the circuit. Using the **Cayley–Hamilton theorem**, *determine* the **inverse of the matrix** A for system stability analysis. | 1b | A | 1 |
| 12. | For analyzing electromagnetic radiation from a cylindrical antenna, spatial coordinates are often expressed in cylindrical form as *Construct* the Jacobian for this transformation. | 2d | E | 2 |
| 13. | The power density of an electromagnetic field is defined as  over the triangular region bounded by the points . *Estimate* the total power transmitted over the triangular surface. | 3b | A | 3 |
| 14. | In a coaxial transmission line the radial amplitude (where is the radial distance from the axis, in appropriate units) satisfies the scale-invariant model *Solve* the corresponding homogeneous Cauchy-Euler equation and write the transient solution . | 4c | E | 4 |
| 15. | In a signal transmission medium, the potential function represents the amplitude of a propagating electromagnetic wave, where the rate of change of potential with respect to and satisfies the nonlinear relation where and . *Compute* the complete integral of the equation. | 5b | E | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | In the state-space representation of an electrical circuit, the system dynamics are given by *Describe*the behavior of the system based on the eigenvalues and eigenvectors. | 1a | An | 1 |
| **(OR)** | | | | |
| 17 | In a satellite communication system, the received signal power depends on three factors such as thermal noise(x), channel fading(y) and antenna misalignment(z). The system behaviour is modeled by the quadratic form: Q(x,y,z) = 10x² + 2y² + 5z² + 6yz – 10xz – 4xy. *Reduce* this quadratic form to its canonical (decoupled) form using orthogonal transformation. | 1d | A | 1 |
|  |  |  |  |  |
| 18 | In a nonlinear signal processing circuit, the output voltage of a filter is modeled as , where represents the instantaneous input voltage (in volts), and represents the time-varying current gain of the nonlinear amplifier. The variations of these parameters with time are given by . Using the **chain rule**, *compute* the **first** and **second total derivatives with respect to t** | 2c | A | 2 |
| **(OR)** | | | | |
| 19 | A delivery drone’s forward speed along a test corridor is influenced by changing wind gusts, automated throttle control and is modeled by  Using differential calculus, determine the times at which the drone attains its **peak (maximum)** and **minimum** speeds, and *find*the corresponding speed values. | 2e | An | 2 |
|  |  |  |  |  |
| 20 | In an edge enhancement operation, the filter energy over a region of an image is given by the functionwith the integral over the region **Change the order of integration** to simplify evaluation and *compute*the total filter energy applied to the image region. | 3c | An | 3 |
| **(OR)** | | | | |
| 21 | 1. A lesion has an intensity function over the square region . *Determine* the total lesion area by integrating the function over the region. 2. The cell density within a tumor tissue is modeled by   where represents the density of tumor cells at a point in suitable units. The tumor occupies a cuboidal region bounded by  *Form and evaluate* the triple integral to determine the total tumor cell volume within the region. | 3d | A | 3 |
|  |  |  |  |  |
| 22 | In a communication circuit, the voltage signal satisfies the equation , where is the time (in seconds) and is the voltage.   1. *Determine* the transient response 2. *Determine* the steady-state response corresponding to the external excitation.   Hence, write the complete response of the circuit. | 4b | A | 4 |
| **(OR)** | | | | |
| 23 | In a communication circuit, the measured voltage signal satisfies , where is time (in seconds). Using the method of variation of parameters, *determine* the transient response, steady-state response and hence write the complete response of the circuit. | 4d | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | In a triangular antenna array, the signal potential at a point is represented by. Coupling between elements produces a nonlinear relation between spatial gradients of the potential and the coordinates. The first-order PDE governing the field is, where and. Using Lagrange's method, *evaluate* the complete integral of the PDE. | 5c | E | 5 |

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

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| **Course Code** | **25EC202** | **Duration** | **3hrs** |
| **Course Title** | **PHYSICAL ELECTRONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | List any four characteristic properties of laser light. | 1a | R | 1 |
| 2. | Classify lasers based on the nature of the active medium with examples. | 1b | An | 1 |
| 3. | State the difference between pitch and loudness. | 2b | R | 2 |
| 4. | Predict the intensity in decibels for the given ratio I/I0=2, where I0 represents the reference intensity. | 2c | U | 2 |
| 5. | Write any four properties of ultrasonic sound waves. | 3a | A | 3 |
| 6. | Define magnetostriction effect. | 3b | R | 3 |
| 7. | Define superconductivity. | 4a | R | 4 |
| 8. | Sketch the resistance-temperature characteristics of superconductor. | 4b | A | 4 |
| 9. | Define de Broglie matter waves. | 5a | R | 5 |
| 10. | List any two important properties of a wave function. | 5c | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Interpret the applications of holography in medical, industrial, and security fields, highlighting the advantages in each case. | 1e | A | 1 |
| 12. | A lecture hall has dimensions 20 m × 10 m × 4 m. The floor area (300 m²) is covered with carpet of absorption coefficient 0.6, and the ceiling (300 m²) is made of plaster with absorption coefficient 0.04. The four walls (240 m²) are of brick with absorption coefficient 0.03. Calculate the reverberation time. | 2c | A | 2 |
| 13. | Construct the piezoelectric generator circuit and explain its working principle. | 3b | A | 3 |
| 14. | Illustrate any one application of superconductors with suitable examples. | 4e | An | 4 |
| 15. | Describe the Davisson–Germer experiment to demonstrate the verification of matter waves. | 5b | U | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | **Determine** the Einstein relations between the coefficients A21, B21, and B12 and discuss their physical significance in laser operation. | 1c | A | 1 |
| **(OR)** | | | | |
| 17 | Illustrate the working principle, modes of vibration, and energy level diagram of a CO2 molecular gas laser with a neat diagram. | 1b | An | 1 |
|  |  |  |  |  |
| 18 | A sound wave travels through air with a velocity of v=350m/s. If its wavelength is λ =0.75 m. Calculate its frequency. Also, explain the important characteristics of musical sound. | 2b | An | 2 |
| **(OR)** | | | | |
| 19 | Illustrate the working principles of dynamic and condenser microphones, and compare their applications in different audio environments. | 2f | A | 2 |
|  |  |  |  |  |
| 20 | Classify and correlate the non-destructive testing using ultrasonic sound waves. | 3c | An | 3 |
| **(OR)** | | | | |
| 21 | Discuss in detail about ultrasonic cleaner with a neat diagram. | 3e | U | 3 |
|  |  |  |  |  |
| 22 | Explain any five important physical properties exhibited by superconductors. | 4c | A | 4 |
| **(OR)** | | | | |
| 23 | Justify the classification of superconductors as Type I and Type II. | 4d | E | 4 |
| **Compulsory Question:** | | | | |
| 24 | Evaluate the working principle, construction, and applications of a Scanning Electron Microscope (SEM) with necessary diagrams. | 5e | E | 5 |

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

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| --- | --- | --- | --- |
| **Course Code** | **25EC203** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF ELECTRICAL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Calculate the resistance of a laptop that draws 2.42 A from an 18.5 V power supply. | 1b | A | 1 |
| 2. | Compute the power consumed by the headlight of a car that draws 5 A current from a 12 V battery. | 1e | A | 1 |
| 3. | Indicate the use of using ELCB in domestic wiring. | 2c | U | 2 |
| 4. | Justify the necessity of tinning of copper cables. | 2a | E | 2 |
| 5. | Calculatethe available usable energy in a 24 V, 70 Ah lead-acid battery that is used till 50% DoD. | 3f | A | 3 |
| 6. | Describe the positioning of the armature in an alternator. | 3b | U | 3 |
| 7. | Diiferentiate between a DC motor and a BLDC motor. | 4a | An | 4 |
| 8. | List the parts of a shaded pole motor. | 4c | R | 4 |
| 9. | State the speed characteristics of a synchronous motor relative to its supply frequency. | 5a | R | 5 |
| 10. | Name the safety feature that a motor control system should incorporate in a domestic lift. | 5d | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Determine the monthly energy consumption of a house using following electrically rated appliances.   |  |  |  |  | | --- | --- | --- | --- | | **Appliance** | **Power Rating** | **No. of Items** | **Hours of use/day** | | LED bulb | 15 W | 4 | 6 | | Refrigerator | 150 W | 1 | 12 | | Laptop | 65 W | 1 | 8 | | 1f | A | 1 |
| 12. | A 50 Hz, 460 V/230 V transformer has 200 turns on the primary and a maximum flux density of 1.0 T. Find secondary turns and core cross-sectional area. | 2e | A | 2 |
| 13. | Explain the suitability of lithium-ion batteries in electric vehicles. | 3f | U | 3 |
| 14. | Infer the mechanical parameters torque and speed of a DC motor. | 4a | An | 4 |
| 15. | Infer the lagging power factor of a 3-phase induction motor and suggest methods to improve it. | 5c | An | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Power is generated at 11 kV and sent to an industrial estate 137 km away. It passes through multiple transformers and power lines, as shown in the system layout. Determine the power received at the estate provided 3 MW of power was sent at a power factor of 0.9. | 1b | A | 1 |
| **(OR)** | | | | |
| 17 | 1. Three resistors are connected in series as shown in circuit. 2. Calculate the total resistance of the circuit. 3. Calculate the total current drawn from the battery. 4. Calculate the voltage drop across 6 Ω resistor.      1. Three resistors are connected in parallel as shown in circuit. 2. Calculate the total resistance of the circuit. 3. Calculate the total current drawn from the battery. 4. Calculate the current flowing through 6 Ω resistor. | 1c | A | 1 |
|  | | | | |
| 18 | A three-phase transformer is connected in delta-wye configuration having turns ratio (phase) a=8, primary line voltage = 12 kV, primary line current = 10 A.  a) Calculate secondary line voltage b) Calculate secondary line current | 2b | A | 2 |
| **(OR)** | | | | |
| 19 | Justify the suitability of MCB over other circuit breakers based on their operating principle, response to overcurrent and short-circuit conditions, reset capability, and response time. | 2c | An | 2 |
|  | | | | |
| 20 | Explain the working of Pelton wheel turbine and Kaplan turbine | 3e | An | 3 |
| **(OR)** | | | | |
| 21 | Describe the process by which a photovoltaic cell (PV) cell converts sunlight into electricity. | 3d | U | 3 |
|  | | | | |
| 22 | Explain the method of commutation, the role of the electronic controller and rotor position sensor in the operation of a brushless DC motor. | 4b | An | 4 |
| **(OR)** | | | | |
| 23 | Explain the structural arrangement and working of a shaded pole motor. | 4c | An | 4 |
|  | | | | |
| **Compulsory Question:** | | | | |
| 24 | Infer the soft-starting mechanism of a three-phase induction motor and its advantages. | 5c | An | 5 |

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

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| **Course Code** | **25EC204** | **Duration** | **3hrs** |
| **Course Title** | **PROBLEM SOLVING USING C FOR ELECTRONICS ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | In a Siemens PLC monitoring system, identify the appropriate data type and format specifier used to display the sensor voltage with two decimal precision. | 1a | U | 1 |
| 2. | List any two tokens in C used to perform arithmetic computation for a Bosch automation valve control. | 1b | U | 1 |
| 3. | Choose the appropriate control structure to switch between “Motor ON” and “Motor OFF” in a Tesla cooling system. | 2a | A | 2 |
| 4. | Choose the appropriate looping construct to perform repetitive sensor data logging in a Bosch IoT device. | 2b | A | 2 |
| 5. | Identify the array type that is suitable to store 50 pressure readings from a Siemens compressor. | 3a | U | 3 |
| 6. | In Tesla’s camera image processing unit, choose an appropriate way to apply arrays for performing pixel-based brightness enhancement. | 3b | A | 3 |
| 7. | In a Bosch data acquisition system, choose the appropriate pointer arithmetic operation required to read consecutive ADC (Analog-to-Digital Converter) values efficiently. | 4a | A | 4 |
| 8. | In a Siemens control application, justify the use of pointers to functions for implementing dynamic control strategies. | 4b | E | 4 |
| 9. | In Tesla’s vehicle diagnostics system, choose the appropriate modular programming construct that helps manage diagnostic functions efficiently. | 5a | A | 5 |
| 10. | In Bosch embedded systems, justify the use of recursion for generating signal waveforms. | 5b | E | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Interpret the structure of a C program controlling Siemens turbine speed using separate declaration, initialization, and output sections. | 1c | A | 1 |
| 12. | In a Tesla robotic welding sequence, choose how break and continue statements can be applied to manage safety cut-offs and skip faulty operations. | 2c | E | 2 |
| 13. | In a Siemens conveyor belt monitoring system, compare sensor readings with the average value by developing an array program to detect potential faults. | 3c | E | 3 |
| 14. | Choose appropriate memory allocation (malloc) to store 100 ADC readings in a Siemens acquisition system. | 4c | E | 4 |
| 15. | Develop a recursive function to compute waveform pattern in a Tesla signal analyzer. | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Develop a program using relevant operators to compute power utilization in a Siemens smart grid module. | 1d | A | 1 |
| **(OR)** | | | | |
| 17 | Develop a C program with proper I/O functions to read and display Tesla motor performance data (RPM, torque). | 1e | A | 1 |
|  |  |  |  |  |
| 18 | Develop a decision-making system for Bosch airbag deployment based on sensor thresholds. | 2d | A | 2 |
| **(OR)** | | | | |
| 19 | For a Tesla radar system simulation, compare waveform signals generated using nested loops in C to identify differences in amplitude or pattern. | 2e | E | 2 |
|  |  |  |  |  |
| 20 | Develop a matrix-based image-sharpening algorithm for Bosch camera. | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | Compare string-handling functions in C and choose the appropriate function to analyze keywords in Tesla voice assistant logs. | 3e | E | 3 |
|  |  |  |  |  |
| 22 | Construct a structure and pointer-based database in C to log vibration data from a Siemens turbine system. | 4d | A | 4 |
| **(OR)** | | | | |
| 23 | Develop an array of structures to store and classify medical images in Bosch healthcare AI. | 4e | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | Develop database operations on Tesla sensor data using file handling. | 5d | A | 5 |

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

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| **Course Code** | **25EC210** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRONICS FOR INTELLIGENT MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Identify the key Industry 5.0 principle, where human operators and collaborative robots work together in precision drug packaging. | 1a | R | 1 |
| 2. | Listany two applications of Cyber-Physical Systems (CPS) in smart manufacturing industries. | 1c | R | 1 |
| 3. | Identifythe sensor type most suitable for detecting transparent bottles positioned at a 20 cm distance on a conveyor belt. | 2a | R | 2 |
| 4. | Identifythe key characteristics and working principle of an Infrared (IR) sensor used for object detection in industrial automation. | 2b | R | 2 |
| 5. | Interpretthe significance of cloud computing in managing large scale industrial data. | 3a | U | 3 |
| 6. | Labelthe different cloud deployment models and explain their characteristics. | 3c | R | 3 |
| 7. | **Choose**the relevant **IoT architecture** suitable for monitoring and controlling a multi-sensor smart greenhouse system. | 4a | A | 4 |
| 8. | **List any two IoT services** that can be deployed for **real-time asset tracking** in a warehouse. | 4e | R | 4 |
| 9. | **Identify** the most suitable **sensor** used in **smart wearables** for tracking body temperature | 5b | R | 5 |
| 10. | **Justify** the **use of Generative AI models** in automating design optimization for smart manufacturing. | 5e | E | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | **Calculate** the yield percentage, defective count and value loss for an intelligent packaging line in a smart industry from the given data and brief the sensor accuracy **and** **cost efficiency** in the systems.  Target = 2,000 items; Sensor count = 1,950; Manual audit = +12 missed, −8 false detections and each product costs ₹50. | 2b | A | 1 |
| 12. | Compute the total monthly storage cost for 30 days if the company adopts the Hybrid cloud model. Based on the scenario, recommend the most appropriate cloud deployment model and provide a justification for your choice.  Given:   * Data generated: 10 GB/day * Cloud pricing:   + Private cloud: ₹6/GB   + Hybrid cloud: ₹4/GB for the first 200 GB, ₹3/GB for any additional storage | 3a | A | 2 |
| 13. | Determinethe total expected latency in a vehicle-to-vehicle (V2V) sensor network. Each node experiences the following delays:   * Sensor processing: 5ms * Transmission: 8ms * Cloud processing: 15ms * IAM (authentication): 2ms   If the system requires a total latency of less than 25ms for safety-critical alerts, verify whether the system meets this requirement and discuss the impact of IAM on overall latency. | 3e | A | 3 |
| 14. | A smart logistics plant has deployed 80 sensor nodes sending 512 bytes of data every 10 Seconds via a 256 kbps gateway.   1. **Calculate**the average bandwidth utilization of the gateway. 2. **Determine** a suitable IoT architecture with a neat sketch and **justify** your choice. | 4c | A | 4 |
| 15. | A collaborative robot assists a human operator in assembling 200 parts/hour. If automation adds 30% speed improvement and consider an error reduction of 5% due to safety constraints.   1. **Calculat*e*** the net productivity gain. 2. **Analyze** its effect on human machine synergy. | 5c | An | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Develop a circuit model of a smart manufacturing line using an Industry 5.0 framework and explain its sustainability and adaptability. | 1a | C | 1 |
| **(OR)** | | | | |
| 17 | Create an intelligent predictive alarm system that detects abnormal vibrations in a CNC machine. Explain the sensor threshold, alarm generation and data logging for maintenance prediction. | 1d | C | 1 |
|  | | | | |
| 18 | Develop an ultrasonic object detection system to measure distance from moving objects in a conveyor. Determine the detection accuracy under varying distances and angles. | 2a | C | 2 |
| **(OR)** | | | | |
| 19 | Design a temperature control system using Arduino for a furnace maintaining 1200 °C. Interpret the controller response and discuss the operation. | 2c | C | 2 |
|  | | | | |
| 20 | Compare Public, Private and Hybrid Cloud models for storing IoT sensor data from 500 devices. Evaluate its storage cost, access time and data security trade. | 3c | E | 3 |
| **(OR)** | | | | |
| 21 | Illustrate the different types of cloud deployment model with necessary examples. | 3b | A | 3 |
|  | | | | |
| 22 | Create a smart warehouse tracking system using RFID and GPS sensors connected to an IoT cloud. Illustrate the system block diagram and justify which IoT protocol is more efficient. | 4e | C | 4 |
| **(OR)** | | | | |
| 23 | Choose a suitable IoT architecture for a smart-factory system with 200 sensors and wireless nodes. Explain data communication and control flow across layers. | 4c | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | Design a cloud-enabled intelligent robotic arm for sorting metallic and non-metallic objects and explain its operation. | 5c | C | 5 |