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

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| **Course Code** | **17EE3013** | **Duration** | **3hrs** |
| **Course Title** | **HYRDOGEN AND FUEL CELLS** | **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. |  | Explain the key properties of hydrogen as an energy carrier. Describe its production by steam reforming, including the reaction, conditions, and pros and cons. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | **Explain the role of hydrogen transmission systems, critically evaluating two different methods used for transporting hydrogen over long distances.** | CO2 | U | 8 |
|  | b. | **Discuss the role of hydrogen in decarbonizing two different sectors**other than passenger vehicles***.* For each sector, explain a specific application and outline the associated technical requirements for hydrogen storage and/or transport.** | CO2 | An | 12 |
|  |  |  |  |  |  |
| 3. |  | Trace the history of Fuel Cell technology and explain its principle, working mechanism, and underlying thermodynamics and kinetics of the electrochemical processes. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare high-temperature fuel cells (SOFC, MCFC) and low-temperature fuel cells (PEMFC, AFC) with respect to start-up time, fuel processing, catalyst needs, and cogeneration potential. | CO4 | An | 12 |
|  | b. | For each of the following applications, choose the most suitable type of fuel cell and justify your choice based on performance, operating conditions, and fuel requirements:   1. Primary power source for a long-haul electric truck 2. Large (200 MW) power plant operating on natural gas | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. |  | Discuss the role of hydrogen in decarbonizing two different sectors other than passenger vehicles. For each sector, explain a specific application and outline the associated technical requirements for hydrogen storage and/or transport. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Compare three hydrogen production methods — electrolysis, biomass gasification, and water splitting — in terms of principle, energy input, and key challenges. Identify which method has the best potential for low-carbon hydrogen and justify your answer. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the performance evaluation of fuel cells and compare their characteristics with those of batteries (electrochemical storage devices). | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the role of hydrogen fuel cell technology in domestic power systems and in large-scale power generation, highlighting its key advantages and limitations. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Discuss the use of hydrogen fuel cell technology in the automobile and space sectors. Also, evaluate its economic and environmental impacts in these areas, and highlight emerging trends in fuel cell development that could shape their future applications. | CO6 | An | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Know detail on the hydrogen production methodologies, possible applications and various storage options. |
| CO2 | Understand the working of a typical fuel cell and its types |
| CO3 | Elaborate on thermodynamics and kinetics of fuel cells |
| CO4 | Analyze the cost effectiveness and eco-friendliness of Hydrogen and Fuel Cells. |
| CO5 | Apply the knowledge about fuel cells in the field of automobiles and space applications. |
| CO6 | Suggest methods of power generation using fuel cells for domestic and large scale purposes. |

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

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| **Course Code** | **18EE3016** | **Duration** | **3hrs** |
| **Course Title** | **DATA MINING FOR RENEWABLE ENERGY SYSTEMS** | **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 novel, scalable data preprocessing pipeline for a heterogeneous wind power plant dataset that contains numerical sensor data, categorical machine status logs, and unstructured maintenance reports. | CO1 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Design a data warehouse–driven renewable energy intelligence system that can integrate, analyze, and mine large-scale renewable energy datasets (solar, wind, and grid data) to identify patterns and actionable insights for improving energy competitiveness. | CO2 | C | 20 |
|  |  |  |  |  |  |
| 3. |  | A renewable energy company uses meteorological and production data to classify the daily power output of a solar farm into three categories: Low, Medium, and High. The dataset includes attributes such as solar irradiance (W/m²), ambient temperature (°C), panel efficiency (%), and humidity (%). Refer the following simplified training data:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Day | Irradiance (W/m²) | Temperature (°C) | Efficiency (%) | Humidity (%) | Output Category | | 1 | 950 | 35 | 90 | 20 | High | | 2 | 800 | 32 | 88 | 35 | Medium | | 3 | 600 | 30 | 85 | 50 | Low | | 4 | 700 | 28 | 86 | 45 | Low | | 5 | 850 | 33 | 89 | 30 | Medium | | 6 | 970 | 36 | 91 | 15 | High |   i). Construct a Decision Tree using Information Gain for the attribute selection at the root node.  ii). Classify a new data instance: Irradiance = 820 W/m², Temperature = 34°C, Efficiency = 88%, Humidity = 25%. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Critically analyze how lazy learners and eager learners differ in their approach to classification and prediction tasks in the context of renewable energy forecasting. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | A smart grid company has collected time-series energy consumption data from 10,000 households over a period of one month. Each household record includes hourly energy usage (kWh), day of week, and weather parameters (temperature, humidity). Using a partitioning clustering method, cluster the households into three energy usage patterns. Describe the steps. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Develop a clustering model to analyze solar power generation patterns from time-series data at different PV sites. Use clustering methods to group profiles, predict energy output for each cluster, and evaluate accuracy with MAPE and RMSE. Discuss implications for renewable energy forecasting and grid management. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Analyze the performance of a small-scale solar power network using classification cascades of overlapping feature ensembles for time series data. Using the available data (voltage, current, irradiance, temperature), identify fault or underperformance patterns. Discuss how ensemble methods improve predictive reliability and evaluate their performance using F1-score and Confusion Matrix. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Develop a data mining model to forecast solar radiation using historical meteorological data (temperature, humidity, irradiance, wind speed) from a solar farm. Discuss how predictive accuracy using Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) improves the model accuracy. | CO5 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Critically analyze the performance of various data mining models for short-term wind power prediction. Design an ensemble forecast combination approach that integrates predictions from multiple models to enhance accuracy. Discuss the potential research opportunities in developing hybrid or physics-informed models for offshore and onshore wind forecasting applications. | CO6 | An | 20 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the importance of data-driven performance optimization of renewable energy system. |
| CO2 | Exploit the vast database available in the renewable energy sector and devise ways to make renewable energy a competitive source of supply |
| CO3 | Classify and analyze different types of data. |
| CO4 | Predict data with error measures. |
| CO5 | Apply data mining for the prediction of power from renewable energy sources. |
| CO6 | Find various research opportunities provided by this field. |

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

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| **Course Code** | **23EE2002** | **Duration** | **3hrs** |
| **Course Title** | **ANALOG ELECTRONIC CIRCUITS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Draw the symbol of a diode. | | CO1 | U | 1 |
| 2. | Give one application of a clamper circuit. | | CO1 | R | 1 |
| 3. | Name the three regions of a BJT. | | CO2 | R | 1 |
| 4. | Define the cutoff and saturation regions of a JFET. | | CO2 | R | 1 |
| 5. | State the purpose of biasing in a BJT amplifier. | | CO3 | U | 1 |
| 6. | What does SPICE stand for? | | CO3 | R | 1 |
| 7. | Define a MOSFET. | | CO4 | R | 1 |
| 8. | Which MOSFET amplifier is also called a source follower? | | CO4 | R | 1 |
| 9. | State the condition for oscillation in a feedback circuit. | | CO5 | U | 1 |
| 10. | Mention one application of an LED. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare the difference between an ideal diode and a practical diode with a neat diagram. | | CO1 | U | 3 |
| 12. | Examine the concept of DC biasing in BJT circuits and its importance. | | CO2 | A | 3 |
| 13. | Summarize the working of a Class A power amplifier with a neat diagram. | | CO3 | U | 3 |
| 14. | Derive the expression for voltage gain of a MOSFET amplifier. | | CO4 | An | 3 |
| 15. | Differentiate between positive feedback and negative feedback with examples. | | CO5 | U | 3 |
| 16. | Explain the working of a Schottky barrier photodiode and mention one advantage. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explore the formation of a PN junction diode. Draw the energy band diagram, depletion region, and explain the V-I characteristics in forward and reverse bias. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Elaborate the structure and operation of an NPN and PNP transistor. Draw its symbol and energy band diagram. Explain the CE input and output characteristics. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Draw the circuit diagram of a UJT relaxation oscillator. Explain its operation in detail. | CO2 | U | 6 |
|  | b. | Examine the concept of h-parameters in BJT and write their significance. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Develop the small-signal equivalent model of a BJT amplifier. | CO3 | A | 6 |
|  | b. | Compare BJT amplifier CE, CC, and CB configurations with respect to gain, input, and output impedance. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Draw and Illustrate the circuit diagram of a Common Source amplifier with its small-signal equivalent circuit of MOSFET. | CO4 | U | 6 |
|  | b. | Derive expressions for voltage gain, input impedance, and output impedance of a CS amplifier. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | With neat diagrams, Interpret the working of a voltage-series feedback amplifier. | CO5 | An | 6 |
|  | b. | Analyze the operation of an **RC phase shift oscillator** with circuit diagram and frequency equation. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Infer the working of a photodiode with a circuit diagram and mention its applications. | CO6 | U | 6 |
|  | b. | Draw and explain the operation of an opto-coupler and discuss one practical application. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Demonstrate the construction and working of a full-wave rectifier. Draw input and output waveforms. | CO1 | An | 8 |
|  | b. | Analyze the function of a diode clipper circuit with a diagram. | CO1 | An | 4 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the characteristics and applications of electronic devices such as diode, BJTs, FET MOSFETs and op-amp |
| **CO2** | Compare various biasing methods for the BJT and MOSFET amplifiers |
| **CO3** | Construct BJT and MOSFET based amplifier circuits with various configurations. |
| **CO4** | Calculate the small signal modelling parameters for a given equivalent circuit. |
| **CO5** | Develop application using special electronic devices |
| **CO6** | Simulate various electronics circuits and analyze its performances |

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

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| **Course Code** | **23EE2003** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL ELECTRONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Determine the number of minterms possible for a 3-variable Boolean function. | | CO1 | A | 1 |
| 2. | State De Morgan’s Theorem. | | CO1 | R | 1 |
| 3. | List the outputs of a Half Adder. | | CO2 | U | 1 |
| 4. | Calculate the number of output lines required for a 4-to-16 line decoder. | | CO2 | A | 1 |
| 5. | Name the two types of triggering used in flip-flops. | | CO3 | R | 1 |
| 6. | Write the basic difference between a latch and a flip-flop. | | CO3 | A | 1 |
| 7. | Determine the number of flip-flops required to design a mod-12 counter. | | CO4 | A | 1 |
| 8. | List two applications of counters in digital systems. | | CO4 | R | 1 |
| 9. | Identify the programmable device that can be reconfigured even after fabrication. | | CO5 | U | 1 |
| 10. | Indicate the operator that is used for bitwise OR in Verilog. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Convert the hexadecimal number **(3A7)₁₆** to its **binary** and **decimal** equivalents. | | CO1 | U | 3 |
| 12. | Differentiate the Serial Adder from the Parallel Adder with respect to speed, hardware, and applications. | | CO2 | An | 3 |
| 13. | Define setup time, hold time, and propagation delay with reference to flip-flop operation. | | CO3 | R | 3 |
| 14. | Compare asynchronous with synchronous counters in terms of their operation and timing characteristics. | | CO4 | An | 3 |
| 15. | List the main functional blocks present in an FPGA architecture. | | CO5 | R | 3 |
| 16. | Write any three differences between dataflow modeling and behavioral modeling in Verilog. | | 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. | A temperature control unit has three input sensors: (i) A (Heater ON signal)  (ii) B (Cooler ON signal) and (iii) C (Temperature threshold reached)  The control output (Y) is HIGH for minterms 1, 2, 3, 5, and 7. Construct the logic function in canonical SOP form and simplify the function using a 3-variable K-map. | CO1 | A | 8 |
|  | b. | Interpret how the NAND gate acts as a universal gate by showing the implementation of AND and NOT functions using only NAND gates. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. |  | A digital system is required to perform binary subtraction as part of arithmetic operations in a microcontroller unit. Construct a full subtractor circuit using two half subtractors and an OR gate to implement this operation. Develop the truth table and derive the Boolean expressions for the Difference and Borrow outputs. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the various types of flip-flops, their operations, truth tables, and characteristic equations. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Construct a 3-bit asynchronous ripple counter and explain its operation with the help of logic and timing diagrams. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Compare and contrast PROM, EPROM, EEPROM, and EAPROM in terms of their programmability and erasability. | CO5 | An | 8 |
|  | b. | Construct a simple Boolean function using PAL and show its programming table. | CO5 | A | 4 |
|  |  |  |  |  |  |
| 22. |  | Construct a 4-to-1 multiplexer using logic gates and explain how it can be used to implement a Boolean function. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Construct a 3-bit serial-in, parallel-out (SIPO) shift register using D flip-flops and illustrate its timing diagram. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the digital design process flow using HDL with a neat block diagram and describe each step briefly. | CO6 | U | 8 |
|  | b. | Write a Verilog program for a Half-Subtractor using any one modelling style. | CO6 | A | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Employ Boolean algebra concepts to design digital circuits, demonstrating the ability to simplify logical expressions, create truth tables, and implement logic functions using gates. |
| **CO2** | Design combinational logic circuits to perform specific functions. |
| **CO3** | Examine sequential circuits, considering timing constraints and understanding state transitions. |
| **CO4** | Implement the Design procedure of Synchronous & Asynchronous Sequential Circuits. |
| **CO5** | Classify the principles of memory and Programmable Logic Devices (PLD) in digital systems. |
| **CO6** | Use simulation tools such as Verilog HDL to model and verify the functionality of digital circuits. |

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

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| **Course Code** | **23EE2004** | **Duration** | **3hrs** |
| **Course Title** | **COMPUTATIONAL ELECTROMAGNETIC FIELDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Prove that the vectors and are perpendicular. | | CO1 | U | 1 |
| 2. | Convert the point P (5,460,750) into rectangular coordinates. | | CO1 | R | 1 |
| 3. | Draw the equivalent circuit of the given composite capacitor.  C:\Users\karunya\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\images (1).jpg | | CO2 | U | 1 |
| 4. | Mention any one application of dielectric polarization. | | CO2 | U | 1 |
| 5. | Define finite difference scheme. | | CO3 | U | 1 |
| 6. | State Courant-Friedrichs-Lewy (CFL) condition. | | CO3 | R | 1 |
| 7. | Mention the number of flux lines which contribute to 1 weber. | | CO4 | R | 1 |
| 8. | Write the mathematical form of Biot-Savart law. | | CO4 | R | 1 |
| 9. | List any two characteristics of uniform plane waves. | | CO5 | R | 1 |
| 10. | List aerospace component faults that are detected using eddy currents. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Draw the differential element in cylindrical coordinate system. Mark all the dimensions. | | CO1 | U | 3 |
| 12. | The tube of a Geiger-Muller counter has a straight wire surrounded by a co-axial conducting shell. The diameter of the wire is 0.0025 cm, diameter of the shell is 2.5 cm, and length of the tube is 10 cm. Find the capacitance of the arrangement. | | CO2 | A | 3 |
| 13. | Outline how irregular boundaries are treated in the FDTD method and mention one technique used to handle curved geometries. | | CO3 | An | 3 |
| 14. | An electromagnetic actuator of a robotic arm has a straight segment of length 50 cm carrying a current of 10 A in positive x-axis. If magnetic field is 0.5 T along negative z-axis, find the magnetic force produced. | | CO4 | A | 3 |
| 15. | A sensitive electronic circuit requires protection from electromagnetic interference (EMI) at a frequency of 100 MHz. A copper sheet () is used as a shield. Calculate the skin depth of copper at 100 MHz. Estimate the minimum shield thickness required to achieve 60 dB attenuation of the electromagnetic field. | | CO5 | An | 3 |
| 16. | State the difference between macroscopic and microscopic forms of Ohm’s law. Also, mention the importance of microscopic form in semiconductor devices. | | 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. | Find the gradient of the scalar field . Interpret the result obtained. | CO1 | A | 4 |
|  | b. | Given a vector field in cylindrical coordinate system, verify Stokes theorem for a circular contour in *xy* plane centered at origin of radius 3 units. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 18. | a. | Calculate the electric field intensity at (0, 4, 3) due to a point charge at origin. | CO2 | A | 4 |
|  | b. | In a cyclone separator, three charged dust particles carry:  Q1 = 1.5 μC, q2 = 2 μC, Q3 = -1 μC  Positions:   * Q1 at origin (0,0) * Q2 at (0.2, 0) m * Q3 at (0, 0.3) m   i). Find the net force on Q1 using vector components.  ii). Determine the magnitude and angle of this force with respect to the x-axis. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 19. | a. | Find the work done in moving a point charge of -10 C from origin to (0, 2, 0). The electric field in the region is V/m. | CO2 | An | 4 |
|  | b. | In a high-voltage transmission line system, a conductor of length “L” carries a uniform line charge density of C/m . Using Gauss’s law, find the electric field intensity at a point located at perpendicular distance “a” from the conductor. Discuss how this field affects the insulation design. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 20. |  | In an electromagnetic lifting device, a circular coil of radius R carries a current I amp. Using the Biot–Savart law, derive an expression for the magnetic field intensity at the center of the circular loop. Briefly explain the importance of knowing the magnetic field intensity in the design and operation of industrial lifting devices. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Using Ampère’s law, derive expressions for the magnetic field intensity in different regions of a co-axial cable used for high frequency communication. Discuss the influence of magnetic field distribution on electromagnetic interference (EMI) with nearby equipment. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the expressions for propagation constant and wave velocity in a dielectric medium when electromagnetic wave is travelling through it. Interpret the significance of propagation constant and wave velocity from the expressions. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | A Faraday’s disc generator has a diameter of 0.5 m which is rotating at 750 rpm. If the disc is influenced by a magnetic field of 0.01 mT. Calculate the emf induced. Suggest methods to increase the emf. | CO6 | A | 4 |
|  | b. | Derive the Maxwell’s equation from Ampere’s law in both integral form and differential form. | CO6 | An | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the basic steps involved in the Finite Element Method (FEM) formulation. Compare Variational and Galerkin methods. Illustrate how shape functions are developed for 2D and 3D finite elements. | CO3 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Explain the computational techniques for computing fields. |
| **CO2** | Apply the techniques to simple real-life problems. |
| **CO3** | Formulate and implement the finite-difference Time-domain method. |
| **CO4** | Identify conventional and state-of-the-art computational electromagnetic techniques for modelling rotating machines and Actuators. |
| **CO5** | Apply electromagnetic wave theories and tools for the applications of wave propagation, radiation, scattering, and in particular, wireless communications. |
| **CO6** | Explain systematically numerical techniques for solving generalized practical electromagnetic problems. |

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

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| **Course Code** | **23EE2008** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRICAL MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term ‘excitation’ in DC machines. | | CO1 | U | 1 |
| 2. | Indicate the component in a DC generator that is responsible for collecting current from the armature and transferring it to the external circuit. | | CO1 | U | 1 |
| 3. | Write the torque equation of a DC motor. | | CO2 | U | 1 |
| 4. | Name any two methods used for testing the efficiency of a DC motor. | | CO2 | R | 1 |
| 5. | Identify the function of the conservator in a transformer. | | CO3 | U | 1 |
| 6. | Indicate the part of a transformer that provides isolation and support between the windings. | | CO4 | U | 1 |
| 7. | Identify the significance of slip in an induction motor. | | CO5 | U | 1 |
| 8. | List two applications of linear induction motors. | | CO5 | R | 1 |
| 9. | Justify the importance of damper windings in synchronous motors. | | CO6 | E | 1 |
| 10. | Differentiate between induction and synchronous motors. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A DC motor has an armature resistance of 0.5 Ω and is connected to a 230 V supply. The back EMF (Eb) generated by the motor is 200 V. Calculate the armature current flowing through the motor. | | CO1 | A | 3 |
| 12. | Differentiate between a separately excited and a self-excited DC generator. | | CO2 | U | 3 |
| 13. | Justify the preference for core-type transformers in high-voltage power transmission applications. | | CO3 | E | 3 |
| 14. | A 3-phase alternator is used in a power plant to generate electricity. If the alternator operates at a frequency of 50 Hz with 4 poles, calculate its synchronous speed. | | CO4 | A | 3 |
| 15. | Summarize the need for different types of starting in an induction motor. | | CO5 | U | 3 |
| 16. | Compare the efficiency of BLDC motors with conventional brushed DC motors. | | CO6 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | A DC series motor takes 40A at 220V. The armature and series field resistances are 0.2Ω and 0.1Ω respectively. Determine the total power loss in the armature circuit. | CO1 | A | 4 |
|  | b. | In a power plant, DC generators are often used for auxiliary power generation or emergency backup systems. Explain the working principle of a DC generator and discuss how it converts mechanical energy into electrical energy for this purpose. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 18. |  | A manufacturing plant requires precise control of conveyor belts for material handling. Analyze which DC motor would be most suitable for this application. Justify your selection based on factors such as torque characteristics, and control requirements. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the testing methods used for transformers and their significance in performance evaluation. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss how a synchronous generators operate in power generation systems. | CO4 | U | 6 |
|  | b. | Evaluate the effects of hunting in synchronous machines and suggest remedies. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the construction and operation of a switched reluctance motor (SRM) with its applications. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | A three-phase induction motor operates at a supply voltage of 415V and a frequency of 50Hz. If the synchronous speed is 1500 RPM and the rotor speed is 1450 RPM, determine the slip and rotor frequency. | CO5 | A | 6 |
|  | b. | Analyze the power flow diagram of an induction motor. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working of a servomotor and its role in robotics. | CO5 | U | 6 |
|  | b. | In industries, synchronous motors are used for precise speed control but require special starting methods. Assess the effectiveness of damper winding in starting a synchronous motor. | CO4 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the challenges and future trends in electrical machine design. | CO6 | A | 6 |
|  | b. | Discuss the impact of energy-efficient motors in industrial applications. | CO6 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the operation of DC Machines. |
| **CO2** | Identify the differences in operation of different DC machine configurations. |
| **CO3** | Examine single phase and three phase transformers circuits. |
| **CO4** | Outline the working of autotransformers. |
| **CO5** | Analyse the effect of parameter variation on torque of Induction Motor and Identify suitable starting, speed control and braking methods for Induction Motor. |
| **CO6** | Comprehend the operation of various types of induction motor and Synchronous motor |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23EE2009** | **Duration** | **3hrs** |
| **Course Title** | **POWER ELECTRONICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the power electronic device that allows bidirectional current flow. | | CO1 | U | 1 |
| 2. | \_\_\_\_\_\_\_\_is the device that is most suited for high switching frequency operation. | | CO1 | R | 1 |
| 3. | The expression for average output voltage of single phase semi-controlled converter for resistive load is given by Vavg = | | CO2 | R | 1 |
| 4. | A three-phase semi converter will require \_\_\_\_\_\_\_\_\_\_ number of SCRs. | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_\_\_\_\_ converts fixed AC to variable AC. | | CO3 | U | 1 |
| 6. | \_\_\_\_\_\_\_ is also termed as variable frequency converter. | | CO3 | R | 1 |
| 7. | Write the expression for the average output voltage of a step-down chopper. | | CO4 | U | 1 |
| 8. | Abbreviate SMPS. | | CO4 | R | 1 |
| 9. | \_\_\_\_\_\_ type of commutation is used in DC Choppers. | | CO5 | U | 1 |
| 10. | Unlike the Ćuk converter, the Zeta converter offers \_\_\_\_\_\_\_\_\_\_ output current. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the necessity of a snubber circuit in power electronic systems. | | CO1 | U | 3 |
| 12. | State the significance of free-wheeling diode in power converters. | | CO2 | U | 3 |
| 13. | List the applications of cycloconverter. | | CO3 | U | 3 |
| 14. | Highlight the control strategies of DC chopper circuit. | | CO4 | U | 3 |
| 15. | List the various applications of an inverter. | | CO5 | U | 3 |
| 16. | Mention the key features of a Super-Lift Luo Converter. | | 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. |  | Examine the static and switching characteristics of a Thyristor (SCR) using neat diagrams. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working of single-phase full converter with neat diagram and waveforms. | CO2 | U | 8 |
| b. | Compare single phase semi converter with full converter. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Describe the working of a single-phase AC full-wave voltage controller with the aid of a neat circuit diagram and corresponding waveforms. | CO3 | U | 8 |
| b. | List the applications of a single-phase AC voltage controller. | CO3 | R | 4 |
|  |  |  |  |  |  |
| 20. | a. | Examine the operation of a four-quadrant chopper using appropriate diagrams and waveforms, and evaluate its influence on motor performance | CO4 | U | 8 |
| b. | Mention any four latest EV models in our Indian market along with the power converters used in them. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the working of 120-degree mode operation of an inverter with neat diagram and waveforms. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | With a neat diagram explain the switching characteristics of Power BJT. | CO1 | U | 8 |
| b. | Explain the significance of using a free-wheeling diode in power converter circuits. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working principle of a step-up DC chopper with the required circuit diagram and waveforms. | CO4 | U | 8 |
| b. | Sketch the diagram of single phase series inverter. | CO5 | R | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Demonstrate the application of power electronics in improving the efficiency of solar PV systems, using a neat diagram. | CO6 | A | 8 |
| b. | Mention any 4 modern power converters used in the power sector. | CO6 | U | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the switching characteristics of power devices and select a suitable power device for power conversion. |
| **CO2** | Design a power converter with criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor). |
| **CO3** | Implement and verify the performance characteristics of power converters. |
| **CO4** | Interpret terminal characteristics of the components for designing the circuitry for power converters. |
| **CO5** | Estimate the required converters for renewable based applications. |
| **CO6** | Assess the quality of power by analyzing the factors such as harmonics, ripples, etc., |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 24 | - | - | - | - | 25 |
| **CO2** | 2 | 19 | - | - | - | - | 21 |
| **CO3** | 5 | 12 | - | - | - | - | 17 |
| **CO4** | 5 | 20 | - | - | - | - | 25 |
| **CO5** |  | 20 | - | - | - | - | 20 |
| **CO6** | - | 8 | 8 | - | - | - | 16 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **23EE2015** | **Duration** | **3hrs** |
| **Course Title** | **COMPUTER AIDED POWER SYSTEM ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | **Define** the purpose of an impedance diagram in power system analysis. | | CO1 | R | 1 |
| 2. | Write the relationship between the phase sequence of positive sequence components and the original three-phase vectors. | | CO1 | R | 1 |
| 3. | **Identify** the type of faults that occur due to short circuits in a power system. | | CO2 | R | 1 |
| 4. | State the role of a synchronous capacitor in a power system. | | CO2 | R | 1 |
| 5. | **State** the normal value of the acceleration factor used in iterative load flow methods. | | CO3 | R | 1 |
| 6. | **List** the pair of power system parameters associated with the Fast Decoupled Load Flow (FDLF) method. | | CO3 | R | 1 |
| 7. | **Compute** the incremental fuel cost of a generating unit whose cost function is F=0.06P2+40P+120 at P=40 MW | | CO4 | A | 1 |
| 8. | **Define** the term Unit Commitment in the context of power system operation. | | CO4 | R | 1 |
| 9. | **Mention the effect on a s**ynchronous machine when transmitted power increases beyond its stability limit. | | CO5 | R | 1 |
| 10. | Define the term Equal Area Criterion (EAC) used in stability analysis of power systems. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A three phase, Δ-Y transformer with rating 10 MVA, 132 KV / 11KV has its primary and secondary leakage reactance as 12 Ω / phase and 0.05 Ω / phase respectively. Calculate the p.u. reactance of transformer. | | CO1 | A | 3 |
| 12. | Write down the properties of Ybus | | CO2 | U | 3 |
| 13. | Classify the type of buses in power system network. | | CO3 | A | 3 |
| 14. | Write the co-ordination equation including losses and explain the terms involved. | | CO4 | U | 3 |
| 15. | List the methods of improving the transient stability limit of a power system. | | CO5 | U | 3 |
| 16. | List the advantages of the Sparse matrix in power system 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. |  | Draw the impedance diagram for the electric power system shown in figure. All the  impedance in per unit on a 100 MVA base. Choose 20 KV as the voltage base for  generator. The three-phase power and line-line ratings are given below.  Generator G1: 90 MVA , 20 KV , X = 9 %  3ΦTransformer T1: 80 MVA , 20 / 200 KV, X = 16 %  3Φ Transformer T2: 80 MVA , 200 / 20 KV , X = 20 %  Generator G2: 90 MVA, 18 KV , X = 9 %  Line: 200 KV , X = 120  Load: 200 KV, S = 48 MW + j64 MVAR. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Obtain the expression for the current during ‘line to ground’ fault that occurs in a power system. | CO2 | U | 6 |
|  | b | Illustrate the dynamics of machines during the stability studies. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Obtain the ZBus for the sample system shown in Figure using Zbus building algorithm. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Fig shows a three bus power system.    Bus 1 : Slack bus, V= 1.05 < 0 p.u.  Bus 2 : PQ bus, P = 3 p.u. and Q=2 p.u  Bus 3 : PQ bus, P=4 p.u., Q=2 p.u.  Carry out one iteration of load flow solution by Gauss Seidel method. Neglect limits on reactive power generation. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Consider a power system with **3 generators** supplying a total demand of PD=850MW. The **cost functions** of the generators (in $/h) are: C1(P1)=0.004P12+5P1+150 100 <P1 < 500  C2(P2)=0.006P22+4.5P2+120 50 <P1 < 300  C3(P3)=0.009P32+4P3+100 50 <P1 < 250.  Find the economic scheduling of all the three plants | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the Runge-kutta method of analyzing the multi machine power system for stability with a neat flow chart. | CO4 | U | 6 |
|  | b. | Write a short notes on Unit commitment and list various constraints. | CO4 | U | 6 |
| 23. | a. | Derive the expression for economic load scheduling of various generator of given power system | CO5 | U | 6 |
|  | b. | The parameters of 4 bus system are as follows:   |  |  | | --- | --- | | Bus Code | Line Admittance (p.u) | | 1-2 | 0.2+j0.8 | | 2-3 | 0.3+j0.9 | | 2-4 | 0.25+j0.1 | | 3-4 | 0.2+j0.8 | | 1-3 | 0.1+j0.4 |   Draw the network and find the bus admittance matrix | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Construct a step-by-step method to solve a large sparse power system matrix using bifactorization while minimizing fill-ins. | CO6 | C | 6 |
|  | b. | The two bus power system is defined with with one transmission line between them. The bus admittance matrix (Ybus) is given by  Using bifactorization method , find upper and lower triangular matrix. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the power system components using single line diagram |
| **CO2** | Analyze the impact of a short-circuit on the power system network |
| **CO3** | Select the circuit breakers and protective devices |
| **CO4** | Perform load flow and stability analysis. |
| **CO5** | Assess the operation of power plants. |
| **CO6** | Design of VAR compensator |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | - | 3 | 12 | - | - | 17 |
| **CO2** | 2 | 9 | 18 | - | - | - | 29 |
| **CO3** | 2 | - | 3 | 12 | - | - | 17 |
| **CO4** | 1 | 21 | 13 | - | - | - | 35 |
| **CO5** | 2 | 9 | - | - | - | - | 11 |
| **CO6** | - | 3 | 6 | - | - | 6 | 15 |
|  | | | | | | | **124** |

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

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| --- | --- | --- | --- |
| **Course Code** | **23EE2016** | **Duration** | **3hrs** |
| **Course Title** | **MICROPROCESSORS AND MICROCONTROLLER** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The 8085 microprocessor has \_\_\_\_\_ pins. | | CO1 | R | 1 |
| 2. | In the 8085 microprocessor, consider the following instructions:  MVI B, 09H  DCR B  After execution, the contents of register **B** will be \_\_\_\_\_\_\_. | | CO1 | A | 1 |
| 3. | The width of the registers in the 8086 microprocessor is \_\_\_\_\_ bit. | | CO2 | R | 1 |
| 4. | In 8086 microprocessor, \_\_\_\_\_\_\_ unit is responsible for fetching instructions. | | CO2 | R | 1 |
| 5. | Give an example for Programmable Communication Interface. | | CO3 | U | 1 |
| 6. | Expand the abbreviation *USART* | | CO3 | R | 1 |
| 7. | The 8051 microcontroller has \_\_\_\_parallel I/O ports, each 8 bits wide. | | CO4 | R | 1 |
| 8. | \_\_\_\_ bytes of bit addressable memory is present in 8051 based microcontrollers. | | CO4 | R | 1 |
| 9. | The PIC microcontroller family is developed by \_\_\_\_\_\_\_Technology. | | CO5 | U | 1 |
| 10. | ESP8266 is a \_\_\_\_bit microcontroller with built-in Wi-Fi. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the interrupt signals available in 8085 microprocessor. | | CO1 | U | 3 |
| 12. | State operating modes of 8086 microprocessor. | | CO2 | U | 3 |
| 13. | Give any three applications of 8255 PPI. | | CO3 | U | 3 |
| 14. | Write short notes on special function register of 8051 microcontroller. | | CO4 | U | 3 |
| 15. | Mention the addressing modes of PIC microcontroller. | | CO5 | U | 3 |
| 16. | List the application of AVR microcontroller. | | 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 8085 microprocessor's architecture using a diagram, focusing on the roles of the ALU, Register Array, and Control Unit. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the segmented memory architecture of the 8086 Microprocessor with a diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the architecture and three primary operating modes (Mode 0, Mode 1, Mode 2) of the 8255 Programmable Peripheral Interface (PPI) | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the 8051 microcontroller's block diagram and explain its hardware architecture. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the different functional units of the PIC microcontroller to execute an instruction cycle, using an appropriate diagram. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | With a neat diagram, explain the operations of the programmable timer/counter - 8254 | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Classify the Instruction Set in 8085 microprocessor. | CO1 | U | 6 |
|  | b. | State the addressing modes supported by 8086 microprocessor. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | With a functional block diagram, explain the working of ESP8266 – a low-cost Wi-fi micro chip | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Design and implement basic assembly language programs for the 8085 microprocessor to  perform arithmetic, logical, and control operations |
| **CO2** | Explain the organization of the 8086 microprocessor's registers, including general  -purpose registers, segment registers, and the instruction pointer. |
| **CO3** | Acquire the knowledge and skills necessary to design, develop, and deploy interfaces between  microcontrollers and various external devices |
| **CO4** | Interpret the architecture of the 8051 microcontroller, including the organization of its registers, memory, and I/O ports. |
| **CO5** | Investigate the functionality and configuration options of various peripheral modules in PIC  microcontrollers |
| **CO6** | Investigate the advanced features and capabilities of ARM processors and AVR controllers using in embedded and IoT applications. |

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

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| **Course Code** | **23EE2017** | **Duration** | **3hrs** |
| **Course Title** | **SMART SENSORS AND DATA ACQUISITION SYSTEM** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the key components of DAS. | | CO1 | R | 1 |
| 2. | Choose a sensor for detecting vehicle proximity. | | CO1 | A | 1 |
| 3. | Define hysteresis in sensors. | | CO2 | R | 1 |
| 4. | Compare analog and digital sensors. | | CO2 | U | 1 |
| 5. | List the sources of noise. | | CO3 | R | 1 |
| 6. | State the function of a notch filter. | | CO4 | U | 1 |
| 7. | State Nyquist frequency. | | CO4 | R | 1 |
| 8. | Choose ADC type for the measurement of fuel level in automobiles that convert at high speed. | | CO5 | U | 1 |
| 9. | Mention the protocol used for Circuit board level communication. | | CO3 | U | 1 |
| 10. | Identify the sensors used in Autonomous Driving Cars. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss the working principle of resistive sensors and provide two examples of sensors that operate on this principle. | | CO1 | R | 3 |
| 12. | An RTD used in the boiler has a range of 0-1000°C and output of 0-24V. Calculate its sensitivity. | | CO5 | A | 3 |
| 13. | Define loading effect. | | CO2 | U | 3 |
| 14. | List the functions of signal conditioning circuits. | | CO4 | R | 3 |
| 15. | Mention the advantages of UART Protocol over other short distance communications | | CO3 | A | 3 |
| 16. | List the benefits of IoT in Healthcare. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the architecture and role of a data acquisition system (DAS). | CO1 | U | 6 |
|  | b. | Illustrate with a diagram the construction and working of LVDT. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Select a sensor for thermal measurement of measurement temperature in a food processing dryer, examine the reasons for the selection in detail. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | A bridge circuit for which R4 varies from 100Ω to 102Ω is shown below. Show how this bridge could be connected to the given instrumentation amplifier to provide an output of 0 to 2.5V for that change in R4. Assume that, in the instrumentation amplifier circuit, R2 = R3 = 1 kΩ and R1 = 100 kΩ. | CO3 | A | 6 |
|  | b. | Apply appropriate filtering techniques to remove 50 Hz power line interference from an ECG signal. Explain your choice of filter type. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the importance of sampling for the data acquisition system with relevant theorem. | CO4 | U | 6 |
|  | b. | Explain the successive approximation technique for the A/D conversion. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Explain main components of Bluetooth architecture, including its functional divisions. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Design a basic block diagram of a smart sensor system for temperature monitoring in an industrial environment.. | CO1 | A | 6 |
|  | b. | A temperature sensor has a sensitivity of 10mV/°C. Calculate the output voltage when the temperature changes from 25°C to 75°C. Discuss the linearity aspect. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Discuss comprehensively the various signal conditioning techniques including amplification, filtering, isolation, and linearization. Explain how each technique improves signal quality for data acquisition. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate emerging trends in IoT-enabled technologies across healthcare and automotive sectors. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate a comprehensive understanding of smart sensor principles and data acquisition system components. |
| **CO2** | Design, implement, and assess smart sensor systems, including their architectures,  communication interfaces, data acquisition methods, signal conditioning techniques, and  reliability measures |
| **CO3** | Design and implement data acquisition systems using appropriate communication protocols and  interfaces. |
| **CO4** | Analyze and evaluate sensor data to derive actionable insights. |
| **CO5** | Develop solutions for real-world applications using smart sensor technologies. |

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

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| **Course Code** | **23EE2018** | **Duration** | **3hrs** |
| **Course Title** | **CONTROL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Interpret the term Control system. | | CO1 | U | 1 |
| 2. | Define manipulated variable. | | CO1 | R | 1 |
| 3. | Identify the order of the given transfer function. | | CO2 | R | 1 |
| 4. | Write the formula for the steady state error ( | | CO2 | R | 1 |
| 5. | Define resonant peak. | | CO3 | U | 1 |
| 6. | Identify the type of graph used in a Bode plot. | | CO3 | R | 1 |
| 7. | State the meaning of Bounded Input Bounded Output (BIBO) stability. | | CO4 | U | 1 |
| 8. | Interpret the term auxiliary equation. | | CO4 | R | 1 |
| 9. | Define controllability. | | CO5 | U | 1 |
| 10. | Mention the other name of PID controller. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate open loop and closed loop systems. | | CO1 | An | 3 |
| 12. | Illustrate the significance of rise time, peak time, and settling time in evaluating system performance. | | CO2 | U | 3 |
| 13. | Determine the phase angle of for the given sinusoidal tranfer function | | CO3 | An | 3 |
| 14. | Discuss the procedure adopted when a row of all zeros appears in the Routh array. | | CO4 | U | 3 |
| 15. | Construct a state model for a system characterized by the differential equation,  State variables are assigned as follows: | | CO5 | An | 3 |
| 16. | Compare the characteristics, advantages, and limitations of PI and PID Controllers in terms of their response and steady-state performance. | | 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. | Determine the transfer function for the given mechanical rotational system. | CO1 | U | 8 |
|  | b. | Find the forward path gains and individual loop gains. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Derive the response of the second order undamped system for unit step input. | CO2 | An | 6 |
|  | b. | Determine the type of input signal that results in a constant steady-state error and calculate the corresponding steady-state error for the servomechanism with the given open-loop transfer function, | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Obtain the gain and phase cross-over frequencies for the following transfer function using Bode plot. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Construct Routh array and determine the stability of the system whose characteristic equation is | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Draw the polar plot for the open-loop transfer function of a unity feedback system given below, and determine the gain margin and phase margin | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Determine the closed loop transfer function of the system whose block diagram is shown below. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Derive the expressions for steady-state error corresponding to different standard input signals in a control system. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate various tuning methods for P, PI, and PID controllers and compare their effectiveness. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Develop mathematical models of control components and physical systems. |
| **CO2** | Analyze the time domain responses of Linear Time Invariant (LTI) systems using the stability analysis methods |
| **CO3** | Analyze the systems' stability using frequency domain techniques |
| **CO4** | Derive equivalent differential equation, transfer function and state space model for a given system |
| **CO5** | Assess the advantages of solving complicated systems with contemporary methods like state space analysis |
| **CO6** | Design controllers for practical engineering applications in Aerospace, Electro mechanical systems |

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

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| --- | --- | --- | --- |
| **Course Code** | **23EE2019** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL SIGNAL PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Find the Nyquist rate for a signal bandlimited to 5 kHz. | | CO1 | U | 1 |
| 2. | Sketch the signal . | | CO1 | U | 1 |
| 3. | Define region of convergence (ROC) with respect to z-transform. | | CO2 | U | 1 |
| 4. | Write the z-transform of unit step sequence. | | CO2 | R | 1 |
| 5. | Define twiddle factor. | | CO3 | U | 1 |
| 6. | List two applications of FFT algorithm. | | CO3 | R | 1 |
| 7. | Mention the main drawback of rectangular window in filter design. | | CO4 | U | 1 |
| 8. | Name the algorithm used for designing equi-ripple FIR filters. | | CO4 | R | 1 |
| 9. | Write the relationship between analog and digital frequency in impulse invariant transformation. | | CO5 | U | 1 |
| 10. | Define spectral analysis in DSP. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Determine the energy and power of unit step sequence. | | CO1 | An | 3 |
| 12. | An LTI system is characterized by Find the output for the given input .    ↑    ↑ | | CO2 | A | 3 |
| 13. | Compare DIT-FFT and DIF-FFT algorithms. | | CO3 | An | 3 |
| 14. | Draw the Linear-Phase FIR filter structure when M is odd. | | CO4 | U | 3 |
| 15. | Find the equivalent digital transfer function by using impulse invariant method for the analog transfer function . Assume . | | CO5 | An | 3 |
| 16. | Voltage and current waveforms in a distribution feeder are analyzed to evaluate power quality. Describe how Discrete Wavelet Transform (DWT) helps in detecting power quality disturbance. Mention the advantages of wavelet analysis over FFT for power quality monitoring. | | 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. | Check whether the given signal is i) causal or non-causal ii) time variant or time in-variant. | CO1 | A | 4 |
|  | b. | A discrete-time system is given by Identify the recursive and non-recursive coefficients. Also, draw an architecture to implement the system. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 18. |  | Plot the given sequence and determine its time-reversed (folded) version.    ↑  Using Python, write a function that performs time folding on any arbitrary discrete-time signal. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Find the z-transform of . | CO2 | A | 4 |
|  | b. | Find the inverse z-transform by partial fraction expansion. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 20. | a. | Determine IDFT of *X(K)*={10, -2+2j, -2, -2-2j} using matrix method. | CO3 | An | 4 |
|  | b. | Given , compute the DFT using matrix method and verify Parseval’s Theorem. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 21. |  | From the first principles, obtain the signal flow graph for computing 8- point DFT using radix -2 DIT–FFT algorithm. Using the above signal flow graph compute DFT of . | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Apply the window method to design a linear phase FIR filter for a given set of specifications, and demonstrate the design procedure with necessary equations. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | A signal contains a low frequency tone that needs to be removed for further analysis. Implement a digital high-pass Butterworth filter in Python that can remove the undesired tone from the signal. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Propose a step-by-step DSP-based fault diagnosis procedure for the wind turbine drivetrain. For each step include: the DSP operation(s) to be applied, and the rationale. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Characterize signals mathematically in continuous and discrete-time, and in the frequency domain. |
| **CO2** | Analyse discrete-time systems using z-transform. |
| **CO3** | Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms |
| **CO4** | Design digital filters for various applications. |
| **CO5** | Implement filters through programming. |
| **CO6** | Apply digital signal processing for the analysis of signals from engineering systems. |

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

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| **Course Code** | **23EE2031** | **Duration** | **3hrs** |
| **Course Title** | **OBJECT ORIENTED PROGRAMMING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The object **\_\_\_\_\_\_\_\_** is used to display output to the standard output device (screen) in C++. | | CO1 | R | 1 |
| 2. | The header file must be included for basic input/output operations in C++ is \_\_\_\_\_ | | CO1 | R | 1 |
| 3. | In C++, \_\_\_\_\_\_\_ is a process in which a function calls itself to solve a problem. | | CO2 | R | 1 |
| 4. | Mention the types of function in C++. | | CO2 | R | 1 |
| 5. | The process of defining more than one function with the same name but different parameters in C++ is called \_\_\_\_\_\_\_ | | CO3 | R | 1 |
| 6. | A function that has the same name as the class and is automatically invoked when an object is created is called a \_\_\_\_\_\_\_ | | CO3 | R | 1 |
| 7. | \_\_\_\_\_\_ is the process by which new classes called derived classes are created from existing classes called base classes. | | CO4 | R | 1 |
| 8. | Mention the two operators used with pointers in C++. | | CO4 | R | 1 |
| 9. | A \_\_\_\_ function can access the private and protected data of a class. | | CO5 | R | 1 |
| 10. | Name any two stream classes used for file handling in C++. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the characteristics of Object-Oriented Programming in C++. | | CO1 | U | 3 |
| 12. | Categorize the operator types and also the list the operators in each category | | CO2 | U | 3 |
| 13. | Recall the key features of constructors in C++ | | CO3 | U | 3 |
| 14. | Highlight the differences between ‘Operator Overloading Functions’ and ‘Normal Functions’. | | CO4 | U | 3 |
| 15. | Justify the need of virtual functions in C++ | | CO5 | U | 3 |
| 16. | Infer the different stream errors that can occur during file I/O operations in C++. | | 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. |  | Write a C++ program to find the following:   * Swapping the variables (without the third variable). * To print the user’s name, age, cgpa and place. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Write a C++ program to find the factorial of a given number using both for and while loops.Read the number from the user | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Write a C++ program using functions and structures to implement a grading assessment system.  The program should:   * Read a student’s name, roll number, and marks. * Calculate the average. * Assign grades based on a criteria. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Build a C++ program to demonstrate public inheritance. Your program should include a base class containing a public data member and a derived class that accesses this member using a member function. Also, show that the public member of the base class can be accessed directly through the derived class object. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Develop a C++ program that uses a friend function to find the larger value between two private data members of two different classes, Class A and Class B. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Write a C++ program to print the multiplication table of a given number. | CO1 | A | 6 |
|  | b. | Write a C++ program to display the following pattern using a for loop:  1  2 2  3 3 3  4 4 4 4  5 5 5 5 5 | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the key features of friend function in C++ | CO5 | U | 4 |
|  | b. | Provide an overview about the exception handling mechanism. | CO4 | U | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Develop a C++ program using file handling to store and display temperature readings of an electrical device using file. Your program should:   * Create a text file named readings.txt * Write **five temperature values** entered by the user into the file * Read the same data from the file and display it on the screen | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Define the object-oriented programming concepts. |
| **CO2** | Select the relevant object-oriented concepts to implement a real time application. |
| **CO3** | Demonstrate the application of polymorphism in various ways. |
| **CO4** | Illustrate the use of advanced features of C++ such as templates, exceptions, and multiple inheritances. |
| **CO5** | Create applications using inheritance in C++. |
| **CO6** | Explain file management and string manipulation. |



END SEMESTER EXAMINATION – NOV / DEC 2025

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| --- | --- | --- | --- |
| **Course Code** | **23EE2072** | **Duration** | **3hrs** |
| **Course Title** | **DIY SKILLS IN ENGINEERING** | **Max. Marks** | **100** |

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| **Q.**  **No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the color used for danger signs. | | CO1 | U | 1 |
| 2. | State one example of personal protective equipment (PPE). | | CO1 | R | 1 |
| 3. | Name the device used to measure current. | | CO2 | R | 1 |
| 4. | Define the term “fuse.” | | CO2 | R | 1 |
| 5. | Describe the function of a radiator. | | CO3 | U | 1 |
| 6. | State the function of serpentine belt. | | CO3 | R | 1 |
| 7. | List any two soldering safety precautions. | | CO4 | U | 1 |
| 8. | State the purpose of flux in soldering. | | CO4 | R | 1 |
| 9. | State the meaning of negligence. | | CO5 | U | 1 |
| 10. | Define mutual consent. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the basic steps in providing first aid | | CO1 | A | 3 |
| 12. | Compare series and parallel wiring. | | CO2 | U | 3 |
| 13. | Describe the working of a car braking system. | | CO3 | A | 3 |
| 14. | Illustrate the basic procedure of filing a case in civil court. | | CO4 | U | 3 |
| 15. | Describe the role of offer and acceptance in contract formation. | | CO5 | A | 3 |
| 16. | Summarize the key steps in field fault 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. | a. | Analyze the importance of workshop safety for beginners. | CO1 | An | 6 |
|  | b. | Explain the role of any three PPE in reducing workplace accidents. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the correct use of different fire extinguishers. | CO1 | R | 6 |
|  | b. | Select the proper tools to improve the safety and performance of various jobs in factories | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Design a fault diagnosis chart for household appliances. | CO2 | U | 6 |
|  | b. | Analyze common issues in washing machine motors, refrigerator and mixer grinder | CO2 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Analyze engine fault and transmission system fault diagnosis techniques and propose solutions for the above faults | CO3 | An | 6 |
|  | b. | Discuss about oil and air filter replacement and spark plug maintenance procedures. | CO3 | R | 6 |
|  |  |  |  |  |  |

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| 21. | a. | Sketch the block diagram of SMPS in power regulation for computers and describe the function of each block. | CO4 | U | 6 |
|  | b. | List the computer ports and connectors used for hardware communication and explain its functions. | CO4 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the soldering and de-soldering process for PCB repair. | CO4 | R | 6 |
|  | b. | Evaluate the role of earthing and safety devices in preventing electric shock. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the step-by-step process of patent filing and evaluate the role of the patent office in examination and grant. | CO5 | A | 6 |
|  | b. | Evaluate the effectiveness of workers’ rights laws in ensuring fair practices. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze any two frequently occurring faults in electrical and mechanical systems and explain to prevent such faults. | CO6 | An | 6 |
|  | b. | List various faults occurring in chemical industries and computer hardware | CO6 | R | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify safety sign and prevent the electrical accidents. |
| **CO2** | Classify the problems related to electrical appliances. |
| **CO3** | Categorize mechanical devices and identify its faults. |
| **CO4** | Recognize and replace various parts of electronic appliances and computers. |
| **CO5** | Apply for legal procedures related to the workplace. |
| **CO6** | Examine and resolve frequently occurring faults in engineering fields |

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

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| **Course Code** | **23EE2074** | **Duration** | **3hrs** |
| **Course Title** | **AI FOR ELECTRIC AND HYBRID VEHICLES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the key characteristics of intelligent agents. | | CO1 | R | 1 |
| 2. | Define the concept of deep learning in Artificial Intelligence. | | CO1 | R | 1 |
| 3. | List any two AI-based parameters used for optimizing powertrain performance. | | CO2 | R | 1 |
| 4. | State the term thermal management in the context of battery systems. | | CO2 | R | 1 |
| 5. | Define the State of Health (SoH) of a battery and its significance. | | CO3 | R | 1 |
| 6. | Write the main objective of an Advanced Driver Assistance System (ADAS). | | CO3 | A | 1 |
| 7. | List the steps involved in obstacle detection in intelligent vehicle systems. | | CO4 | R | 1 |
| 8. | Indicate the purpose of predictive maintenance in electric vehicles. | | CO4 | U | 1 |
| 9. | Identify one emerging trend of Artificial Intelligence in Electric and Hybrid Vehicles (EHVs). | | CO5 | U | 1 |
| 10. | Interpret the term carbon footprint with reference to electric vehicle operation. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare the role of Artificial Intelligence in traditional and modern automotive systems. | | CO1 | U | 3 |
| 12. | Differentiate between rule-based and machine learning–based strategies for energy management in EVs. | | CO2 | U | 3 |
| 13. | Assess how AI techniques improve the effectiveness of thermal management in electric vehicle batteries. | | CO3 | E | 3 |
| 14. | Illustrate how AI helps vehicles detect lanes in autonomous driving. | | CO4 | U | 3 |
| 15. | Justify the use of AI algorithms for fault detection and reliability improvement in EV systems. | | CO5 | E | 3 |
| 16. | Write the significance of combining IoT and AI technologies for connected 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. | a. | As automobile companies transition from traditional to AI-driven electric and hybrid models, explain the evolution of Artificial Intelligence in Electric and Hybrid Vehicles and its current applications in the automotive industry. | CO1 | An | 6 |
|  | b. | Discuss any two AI architectures and explain their applications in modern automotive systems. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Engineers are developing an energy-efficient inverter control system for an electric vehicle. Explain how AI-based optimization improves inverter performance and energy flow management. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | A startup is designing an intelligent BMS for accurate battery health estimation in electric vehicles. Explain the AI-based BMS model used for estimating the State of Charge (SoC) and State of Health (SoH). | CO3 | An | 6 |
|  | b. | Explain how predictive analysis and policy iteration techniques enhance battery performance and lifespan. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain with suitable sketches how sensor fusion techniques contribute to accurate environmental perception in autonomous systems. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | As an EV maintenance system is being developed using machine learning models, illustrate how these algorithms enable predictive maintenance and fault classification in electric vehicles. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | An autonomous vehicle company is working on improving road safety using AI-powered vision systems. Discuss AI-based computer vision algorithms used for Advanced Driver Assistance Systems (ADAS) and path planning. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the structure and functioning of an AI-based real-time vehicle health monitoring system applied in automotive diagnostics and performance monitoring. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | In a smart city project deploying connected and sustainable electric vehicles, assess how AI integration contributes to the development of intelligent and eco-friendly mobility ecosystems. | CO6 | E | 6 |
|  | b. | Discuss the emerging trends of Artificial Intelligence applications in Electric and Hybrid Vehicles. | CO6 | U | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply AI concepts in modelling and simulation of EHVs. |
| **CO2** | Design AI algorithms for optimal control of vehicle dynamics and powertrain systems. |
| **CO3** | Develop machine learning models for energy management in EHVs. |
| **CO4** | Evaluate AI-based solutions for fault detection, diagnostics, and predictive maintenance. |
| **CO5** | Analyze the impact of AI on the efficiency and sustainability of EHVs. |
| **CO6** | Evaluate the integration of IoT and AI for emerging applications. |

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

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| **Course Code** | **23EE2075** | **Duration** | **3hrs** |
| **Course Title** | **BIG DATA ANALYTICS FOR SMART GRID** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State one reason why data analytics is vital for modern power grids? | | CO1 | R | 1 |
| 2. | Differentiate between traditional grid and smart grid in terms of communication. | | CO1 | U | 1 |
| 3. | Name one statistical tool used for handling noisy data. | | CO2 | R | 1 |
| 4. | Define data quality in smart grids. | | CO2 | R | 1 |
| 5. | Identify one advantage of using NumPy in large-scale computations. | | CO3 | R | 1 |
| 6. | List one Pandas feature that supports energy trend analysis. | | CO3 | R | 1 |
| 7. | State one difference between linear and logistic regression. | | CO4 | R | 1 |
| 8. | Name the core data structure used in Pandas. | | CO4 | R | 1 |
| 9. | Identify one merit of K-Means for large datasets. | | CO5 | R | 1 |
| 10. | Mention any one advantage of hybrid cloud–edge architecture. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the impact of data analytics in grid reliability and efficiency. | | CO1 | An | 3 |
| 12. | Compare SCADA and AMI systems used in data acquisition. | | CO2 | U | 3 |
| 13. | Demonstrate the Pandas Data Frame can be used for data filtering and sorting. | | CO3 | An | 3 |
| 14. | Differentiate between the linear and logistic regression with examples. | | CO4 | U | 3 |
| 15. | Explain the need for renewable energy integration using big data analytics. | | CO5 | An | 3 |
| 16. | Highlight the need of cloud computing in the scalable smart grid data storage. | | 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 architecture of a smart grid with a neat sketch. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Appraise the major differences between traditional and smart grids in terms of monitoring, communication, and control. | CO2 | An | 8 |
|  | b. | Explain the major challenges in ensuring data quality for energy analytics. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. |  | Explain the architecture and working of Advanced Metering Infrastructure (AMI). | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Design a sample dashboard layout for real-time monitoring of grid parameters. | CO4 | C | 8 |
|  | b. | Justify how data preprocessing improves model accuracy. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe the architecture of a neural network used for energy prediction. | CO5 | U | 6 |
|  | b. | Explain the various types of anomalies that can occur in smart grid data and suggest ML-based detection methods. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare cloud computing and edge computing for real-time smart grid applications. | CO5 | An | 8 |
|  | b. | Explain the concept of clustering for consumer segmentation. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 23. |  | Explain the integration of IoT, AI, and big data technologies for future smart grid development. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design a hybrid cloud–edge architecture to support real-time energy monitoring and analytics. | CO6 | C | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate an understanding of the role and importance of data analytics in smart grids. |
| **CO2** | Apply data science techniques to pre-process, analyse, and visualize smart grid data. |
| **CO3** | Use popular tools and programming libraries for big data analytics in energy systems. |
| **CO4** | Implement machine learning algorithms for predictive modelling and anomaly detection in smart grids. |
| **CO5** | Analyze case studies to evaluate the practical applications of big data analytics in smart grids. |
| **CO6** | Develop integrated cloud and edge computing solutions for scalable and efficient smart grid analytics. |

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

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| **Course Code** | **25EE201** | **Duration** | **3hrs** |
| **Course Title** | **LINEAR ALGEBRA AND CALCULUS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | *Identify* any two eigenvalues of , where is the conductance matrix. | 1a | R | 1 |
| 2. | *Identify* the nature of the quadratic form | 1e | R | 1 |
| 3. | *List* the standard basis of the vector space | 2a | R | 2 |
| 4. | *Identify* whether the subset is a subspace of | 2a | U | 2 |
| 5. | If represents the voltage as a function of variables and , then *identify* | 3a | U | 3 |
| 6. | *Identify* the degree of the homogeneous function | 3b | R | 3 |
| 7. | The total power dissipated on a circular resistive disk is represented in Cartesian coordinates as *Identify* the corresponding polar form of the integral. | 4d | R | 4 |
| 8. | *Compute*. | 4c | A | 4 |
| 9. | *Compute* the curl and divergence of an electric field in a region is defined by | 5a | A | 5 |
| 10. | *Compute* the velocity and acceleration of the voltage vector is at time t= 5 minutes. | 5b | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | A series RLC circuit has R=1.5Ω, L=0.2H, C=0.01F. *Determine* the numeric matrix, damping factor αr and damped frequency ωd. | 1b | A | 1 |
| 12. | A resistive voltage divider has resistances and . The input voltage is .   1. *Express* as a linear transformation of . 2. If and , *compute* using linearity. | 2a | U | 2 |
| 13. | For spherical polar coordinates  *determine* the Jacobian | 3c | A | 3 |
| 14. | An electrical signal over a triangular plate is given by . *Calculate* the intensity over the region bounded by , and . | 4a | A | 4 |
| 15. | An electric field in a region is given by . Determine whether the electric field is irrotational. If it is irrotational, *find* a scalar potential function such that . | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | *Compute*the eigen values and eigen vectors of the Conductance Matrix  . | 1b | A | 1 |
| (OR) | | | | |
| 17 | Consider a series RLC circuit with parameters: . Using diagonalization, *determine* the expression for the i and capacitor voltage . | 1c | U | 1 |
|  | | | | |
| 18 | A circuit with three nodes has the incidence matrix .  The branch current vector is *Compute* the range of , the rank of , and interpret the result. | 2d | An | 2 |
| (OR) | | | | |
| 19 | In a three-branch resistive network, the branch current responses (in amperes) to three independent voltage sources are given as . *Determine* that these vectors are linearly independent and interpret the result. | 2e | An | 2 |
|  | | | | |
| 20 | The power loss in a resistive network depends on two adjustable resistances and : . *Determine* the values of and that minimize the power loss, and find the minimum value. | 3d | An | 3 |
| (OR) | | | | |
| 21 | *Compute* the extrema of subject to where represents the power distribution between two branches in an AC circuit, and is the total supplied power. | 3e | An | 3 |
|  | | | | |
| 22 | The electric field intensity over a region is represented by  . *Evaluate* the integral by changing the order of integration. | 4c | E | 4 |
| (OR) | | | | |
| 23 | The energy density at a point in a 3D resistive medium is given by The medium occupies a cuboidal region bounded by , and . *Evaluate* the total energy stored in the cuboidal region by integrating the energy density over the volume. | 4f | E | 4 |
|  | | | | |
| **Compulsory Question:** | | | | |
| 24 | The electric flux density in a region is given by The field exists within a cube bounded by the planes . *Evaluate* the total electric flux leaving the cube using the Gauss Divergence Theorem. | 5e | E | 5 |

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

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| **Course Code** | **25EE204** | **Duration** | **3hrs** |
| **Course Title** | **ELECTRICAL ENGINEERING MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | | |
| 1. | Write the formula for electrical resistance in terms of resistivity, length, and area. | 1a | R | 1 |
| 2. | Explain the reason for using aluminum over copper for overhead power transmission lines. | 1d | U | 1 |
| 3. | Name any two dielectric materials. | 2a | R | 2 |
| 4. | Explain the importance of breakdown strength of a dielectric material in high voltage applications. | 2b | U | 2 |
| 5. | Name the type of magnetic material suitable for transformer cores, inductors and other AC applications. | 3a | R | 3 |
| 6. | Explain Magnetic flux density. | 3b | U | 3 |
| 7. | Discuss the harsh environmental conditions under which a photodetector operates in real-world applications. | 4d | U | 4 |
| 8. | Name any one direct and indirect bandgap material used in photodetectors and diode lasers, respectively. | 4a | R | 4 |
| 9. | List two examples for biomass system. | 5e | R | 5 |
| 10. | Discuss the type of materials to be used in geothermal power plants. | 5d | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | | |
| 11. | A copper wire of length 2 km and cross-sectional area 1 mm² is used in a circuit. The resistivity of copper is ρ=1.68×10−8 Ω⋅m.  (a) Determine the formula for the resistance of the wire. (b) Calculate the resistance of the wire. (c) If the wire is replaced with an aluminum wire of the same length and cross-sectional area, determine its resistance given ρAl=2.82×10−8 Ω⋅m | 1a | A | 1 |
| 12. | Discuss any two types of polarization with required schematic diagram. | 2b | U | 2 |
| 13. | A small soft iron rod is placed in an external magnetic field of H = 500 A/m. The rod has a magnetic susceptibility χ = 2000.   1. Calculate the magnetization M of the rod. 2. Calculate the magnetic flux density B inside the rod. (Use μ₀ = 4π × 10⁻⁷ H/m) | 3b | A | 3 |
| 14. | A GaAs (Gallium Arsenide) diode laser is used as an optical source in the fiber-optic communication system of an aircraft’s avionics network. If the bandgap energy of GaAs is 1.43 eV,   1. Calculate the wavelength of the emitted laser light. 2. Determine the importance of bandgap in selecting materials for   electrical and electronic systems used in aerospace applications. | 4a | A | 4 |
| 15. | A circular polymer-composite rod used as a substrate in a foldable display has a diameter of **2.5 mm** and a gauge length of **40 mm**. In a tensile test the rod breaks under a load of **420 N** after an extension of **1.20 mm.** Calculate the **tensile strength** of the polymer composite (in MPa) and mention the applications in flexible electronics. | 5b | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | | |
| 16 | Infer the role of Phase-Change Materials versus Heat Sinks for Battery Thermal Management with emphasis on the Role of Latent Heat and Specific Heat. | 1b | An | 1 |
| **(OR)** | | | | | |
| 17 | Justify the use of **conductive textiles, flexible conductors, and phase change materials** instead of traditional heat sinks in wearable electronics, with suitable examples. | 1e | E | 1 |
|  | | | | |
| 18 | Evaluate the role of different dielectric materials on the performance of a capacitor to be used in applications that demand any of the following criteria.   1. Compact capacitors 2. Flexible capacitors 3. Capacitors for high temperature applications. | 2c | E | 2 |
| **(OR)** | | | | | |
| 19 | Infer the use of polymer materials in piezoelectric sensors with suitable diagrams on construction and working of sensors. | 2e | An | 2 |
|  | | | | |
| 20 | Infer any three reasons for magnetic energy losses in transformer cores and mention the methods of minimization. | 3b | An | 3 |
| **(OR)** | | | | | |
| 21 | Justify the usefulness of **soft** and a **hard magnetic material in transformer based on their hysteresis loop.** Support your answer with a neat schematic diagram on hysteresis loop. | 3d | E | 3 |
|  | | | | |
| 22 | Discuss the factors that make the photodetectors usable for optical fiber communication system, medical electronics and in industry applications with a neat diagram on its construction and working principle. | 4d | U | 4 |
| **(OR)** | | | | | |
| 23 | Evaluate the type of Optical Fiber Cable (OFC) suitable for a diode laser in compact electronic applications. Support your answer with the construction and working of Single Mode Fiber (SMF) and Multi-Mode Fiber (MMF). | 4b | E | 4 |
| **Compulsory Question:** | | | | | |
| 24 | Evaluate the role of different components of a lithium-ion battery that could withstand different climates. Support your answer with a neat diagram showing its construction and working principle. | 5e | E | 5 |

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

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| **Course Code** | **25EE213** | **Duration** | **3hrs** |
| **Course Title** | **PYTHON PROGRAMMING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Explain the purpose of type conversion in Python with an example. | 1c | U | 1 |
| 2. | List any two data types in Python and give one example for each. | 1b | R | 1 |
| 3. | List the different looping statements available in Python. | 2b | R | 2 |
| 4. | Explain the purpose of parameters and return statements in a Python function with a suitable example. | 2c | U | 2 |
| 5. | Highlight the difference between set, tuple and dictionary in python. | 3a | R | 3 |
| 6. | List and explain any two file modes used in Python with their purpose. | 3d | R | 3 |
| 7. | List any two commonly used Turtle graphics functions. | 4a | R | 4 |
| 8. | Describe the Python Imaging Library (PIL) that supports image handling in programs. | 4d | U | 4 |
| 9. | Define the purpose of the Tkinter module in Python. | 5b | R | 5 |
| 10. | Explain the function of mainloop() in a Tkinter application. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Explain the different data types available in Python with suitable examples. | 1b | U | 1 |
| 12. | Explain the purpose of the break and continue statements in Python. Illustrate their difference with suitable examples. | 2b | U | 2 |
| 13. | Write a Python program to display all odd numbers from a given list using a loop and conditional statement. | 3a | A | 3 |
| 14. | Develop a Python program using the Turtle graphics module to draw concentric circles whose radius increases in every iteration of a loop. | 4a | A | 4 |
| 15. | Write a Python program using Tkinter to create a window with a label “Welcome to EEE Department” and a button “Close” that closes the window when clicked. | 5b | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Develop a Python program to compute power dissipation in series and parallel circuits and interpret the resulting values for different resistor configurations. | 1f | A | 1 |
| **(OR)** | | | | |
| 17 | Write a Python script that generates truth tables for basic logic gates using loops to verify logical operations. | 2f | A | 2 |
|  |  |  |  |  |
| 18 | Assess the accuracy and efficiency of motor speed computation performed through various Python list operations, emphasizing performance and reliability aspects. | 3a | A | 3 |
| **(OR)** | | | | |
| 19 | Design a Python program using Turtle Graphics to draw a pattern consisting of multiple geometric shapes (circle and square) in different colors. | 4b | A | 4 |
|  |  |  |  |  |
| 20 | Develop a Python program to calculate and visualize Ohm’s Law (V = IR) for various resistor values, current, and voltage combinations, and discuss the results based on typical circuit conditions. | 1c | A | 1 |
| **(OR)** | | | | |
| 21 | Develop a Python program to calculate the Body Mass Index (BMI) based on user inputs for height and weight. The program should classify the BMI into categories such as underweight, normal weight, overweight, and obesity. | 2b | A | 2 |
|  |  |  |  |  |
| 22 | Examine the computational logic of a Python function designed as a resistor color code calculator and distinguish the mapping between color bands and resistance values. | 2b | An | 3 |
| **(OR)** | | | | |
| 23 | Appraise the effectiveness of using a dictionary for storing and retrieving motor parameters in a Python program. | 3c | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | Design a Python Tkinter-based GUI application to calculate electrical power (P = V × I). The interface should allow the user to enter voltage and current values, and display the calculated power when a button is clicked. | 5d | A | 5 |