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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 07 – 01- 2025 **Time:** 09.30 am to 12.30 pm |

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| **School:** School of Engineering | **Program:** B. Tech (EEE) | |
| **Course Code :** EEE3031 | **Course Name :** Electrical Power Utilization | |
| **Semester**: VII | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **24** | **24** | **26** | **26** | **-** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10 x2 Marks=20 Marks** | | | | |
| **1** | Define resistance heating and name two appliances that utilize this method. | **2 Marks** | **L1** | **CO1** |
| **2** | State the key difference between resistance welding and arc welding. | **2 Marks** | **L1** | **CO1** |
| **3** | List the types of lighting used for floodlighting applications. | **2 Marks** | **L1** | **CO2** |
| **4** | What is an integrating sphere, and how is it used in photometry? | **2 Marks** | **L1** | **CO2** |
| **5** | Identify the key differences between AC and DC traction motors. | **2 Marks** | **L1** | **CO3** |
| **6** | Define regenerative braking and explain its primary benefit in electric traction systems. | **2 Marks** | **L1** | **CO3** |
| **7** | List the different methods of track electrification and provide one example of each. | **2 Marks** | **L1** | **CO3** |
| **8** | List the factors that affect specific energy consumption in electric traction. | **2 Marks** | **L1** | **CO4** |
| **9** | Define specific energy consumption, and why is it a critical parameter in electric traction analysis? | **2 Marks** | **L1** | **CO4** |
| **10** | List the factors that influence the coefficient of adhesion in electric traction systems. | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions. Total 80 Marks.** | | | | | |
| **11.** | **a.** | Describe the working principle of resistance heating and explain why it is commonly used in applications like electric ovens and water heaters. | **10 Marks** | **L2** | **CO1** |
|  | **b.** | Imagine you need to increase the temperature of a 30 m³ room from 15°C to 25°C using an electric heater. The heater has a resistance of 20 ohms and operates on a 220 V power supply. The air's specific heat capacity is 1005 J/kg°C, and its density is 1.2 kg/m³. Assume no heat is lost. Calculate:   1. The power output of the heater. 2. The time required to heat the room to the desired temperature. | **10 Marks** | **L3** | **CO1** |
| **or** | | | | | |
| **12.** | **a.** | Describe the key factors to consider when designing electrical heating systems | **10 Marks** | **L2** | **CO1** |
|  | **b.** | Imagine you are boiling water using an electric kettle. The kettle’s heating element has a resistance of 35 ohms and is powered by a 220 V supply. You aim to heat 2 liters of water from an initial temperature of 28°C to a final temperature of 110°C. The specific heat capacity of water is 4500 J/kg°C, and no heat loss occurs.  Calculate:   1. The power consumed by the kettle. 2. The time needed to heat the water to the target temperature. | **10 Marks** | **L3** | **CO1** |
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| **13.** | **a.** | Explain how the main objectives of street lighting influence the design considerations for a residential area versus a high-speed highway. | **10 Marks** | **L2** | **CO2** |
|  | **b.** | Two sources of having luminous intensity 400 candela are hung at a height of 10 m. The distance between the two lamp posts is 20 m.  Solve for the illumination:  i. beneath the lamp and ii. in the middle of the posts. | **10 Marks** | **L3** | **CO2** |
| **or** | | | | | |
| **14.** | **a.** | Summarize how the type of road (e.g., local streets, arterial roads, expressways) determines the selection of street lighting design schemes. Provide examples of specific pole arrangements suitable for each road type | **10 Marks** | **L2** | **CO2** |
|  | **b.** | The problem specifies that the illumination at a point on a working plane directly beneath the lamp should be 60 lumens/m². The lamp emits 130 candela (CP) uniformly downward from the horizontal plane. Determine the height at which the lamp should be suspended and the illumination at a point on the working plane located 2.8 meters away from the lamp's vertical axis. | **10 Marks** | **L3** | **CO2** |

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| **15.** | **a.** | Using a suitable diagram, explain the speed–time curve of a train operating on a mainline service and its relevance to scheduling and energy consumption. | **10 Marks** | **L2** | **CO3** |
|  | **b.** | An electric train with a mass of 300,000 kg is moving at 54 km/h (15 m/s). It decelerates to 36 km/h (10 m/s) using regenerative braking. Assume the efficiency of energy recovery is 80%. Calculate the total energy recovered during the process. | **10 Marks** | **L3** | **CO3** |
| **Or** | | | | | |
| **16.** | **a.** | Describe how electric traction contributes to the efficiency and sustainability of modern railway operations. | **10 Marks** | **L2** | **CO3** |
|  | **b.** | An electric tram with a mass of 1,500 kg is moving at a velocity of 20 m/s. The tram starts to decelerate using a regenerative braking system. The efficiency of the system is 80%, and the wheels have a radius of 0.3 meters. Assume the tram decelerates uniformly at 2 m/s² for 5 seconds. Identify the unknown parameters that could be found from the given data and compute the same. | **10 Marks** | **L3** | **CO3** |

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| **17.** | **a.** | Explain the concept of tractive effort in electric traction. How is it influenced by the adhesive weight of the train and the coefficient of adhesion? Discuss how these factors interact to determine the maximum achievable acceleration of a train. | **10 Marks** | **L2** | **CO4** |
|  | **b.** | A goods train weighing 800 tonnes is descending a gradient of 1.5%. The train resistance is 30 N/t, and the braking force provided by the locomotive is 20,000 N. Determine the net force acting on the train and its acceleration if the brakes are applied. | **10 Marks** | **L3** | **CO4** |
| **Or** | | | | | |
| **18.** | **a.** | Explain the role of adhesive weight and the coefficient of adhesion in electric traction. Discuss how these factors affect the maximum tractive effort and the braking performance of a train, especially under varying track conditions (e.g., dry, wet, or icy). | **10 Marks** | **L2** | **CO4** |
|  | **b.** | An electric train has the following characteristics: Mass of the train (M): 500 tons (1 ton = 1000 kg), Distance traveled (D): 65 km, Average speed: 70 km/h, Traction power required: 1000 kW, Regenerative braking efficiency: 85% (of braking energy is recovered), Energy consumption over the trip (E): 4000 kWh. Determine the Specific Energy Output of the train in kWh/ton-km. | **10 Marks** | **L3** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***