58/Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 11 – 12- 2025 **Time:** 01:00pm – 04:00pm

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

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**24**	**24**	**14**	**14**	**24**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. 10Q x2M=20M				
1	What are the essential components of electric welding equipment?	**2 Marks**	**L1**	**CO1**
2	What is the principle of resistance heating, and where is it commonly used?	**2 Marks**	**L1**	**CO1**
3	List the various types of Floodlights based on their beam spread angle according to NEMA (National Electrical Manufacturers Association) standards.	**2 Marks**	**L1**	**CO2**
4	Define the following terms; a. Illumination and b. Luminous intensity.	**2 Marks**	**L1**	**CO2**
5	What are the characteristics of traction motors that make them suitable for railway applications?	**2 Marks**	**L1**	**CO3**
6	Identify the different types of speed-time curves used in rail transport and give a scenario where each type is applied.	**2 Marks**	**L1**	**CO3**
7	Define regenerative braking and explain its primary benefit in electric traction systems.	**2 Marks**	**L1**	**CO4**
8	Define tractive effort and explain its significance in electric traction systems.	**2 Marks**	**L1**	**CO4**

9	List the factors that affect specific energy consumption in electric traction.	2 Marks	L1	CO5
10	Define specific energy consumption, and why is it a critical parameter in electric traction analysis?	2 Marks	L1	CO5

Part B

Answer the Questions Total 80 Marks.

11.	**a.**	Explain the function of each major component in an electric welding setup and describe how these components work together to ensure an effective welding process.	**10 Marks**	**L2**	**CO1**
	b.	Suppose you are using an electric kettle to boil water in a household kitchen. The kettle's heating element has a resistance of 35 Ω and is connected to a 220 V power supply. You need to heat 2 liters of water from 28°C to 110°C, assuming no heat loss. The specific heat capacity of water is 4500 J/kg°C. Using the given information, apply the appropriate electrical and thermal formulas to determine: (i) the power consumed by the kettle, and (ii) the time required to heat the water to the desired temperature.	**10 Marks**	**L3**	**CO1**

or

12.	**a.**	Describe how dielectric heating works and explain, with examples, how industries use this method to heat non-conductive materials such as plastics or rubber.	**10 Marks**	**L2**	**CO1**
	b.	Two heating elements are connected to the same 220 V supply—one with a resistance of 60 Ω and the other with 80 Ω. Apply the relevant electrical power and heat energy formulas to calculate the power consumed and the heat produced by each element in 8 minutes. Based on your calculations, determine which element uses more electrical energy.	**10 Marks**	**L3**	**CO1**

13.	**a.**	Imagine you are part of a municipal team responsible for assessing the quality of street lighting in a residential area. To carry out the evaluation, you are provided with a photometer. Explain the basic working principle of the photometer and describe how it helps you determine whether the street lighting system is performing effectively.	**10 Marks**	**L2**	**CO2**
	b.	Imagine you are evaluating the lighting adequacy of a rectangular room measuring 10 × 6 × 2 meters. A light source with a luminous intensity of 600 candela is installed at the center of the ceiling. Using this setup, calculate the	**10 Marks**	**L3**	**CO2**

		illumination at each corner of the room as well as at the midpoint of the 6-meter wall			

or

14.	**a.**	Imagine you are assisting a lighting engineer in selecting suitable lighting for a new sports complex and nearby building facade. To support the decision-making process, describe the key characteristics of floodlights and explain how different types of floodlights are appropriate for various applications, such as illuminating sports arenas or enhancing the appearance of building facades.	**10 Marks**	**L2**	**CO2**
	b.	As an electrical engineer, you are responsible for designing a street lighting system for a newly developed suburban road. The road is 200 meters long and 10 meters wide, with a required illuminance level of 20 lux. You plan to use LED luminaires with a luminous efficacy of 120 lumens per watt, mounted at a height of 8 meters. A uniformity ratio of 0.7 and a maintenance factor of 0.85 are specified for the design. Based on these requirements, calculate the total luminous flux needed, determine the number of luminaires required, and recommend appropriate pole spacing.	**10 Marks**	**L3**	**CO2**

15.	**a.**	Imagine you are part of a railway planning committee responsible for selecting the most suitable traction system for a new intercity rail route. The options under consideration are electric traction, diesel traction, and steam traction. To support the decision-making process, compare these three systems in terms of environmental impact, cost efficiency, and overall operational performance.	**10 Marks**	**L2**	**CO3**
	b.	A train operates between two stations spaced 1.6 km apart, maintaining an average speed of 36 km/h. If the maximum speed is limited to 72 km/h, with an acceleration of 2.7 km/h/s, a coasting retardation of 0.18 km/h/s, and a braking retardation of 3.6 km/h/s, determine the durations of the acceleration, coasting, and braking phases. Assume a simplified speed–time curve.	**10 Marks**	**L3**	**CO4**

Or

16.	**a.**	Using a detailed diagram, explain the significance of the speed–time curve for a train operating on a mainline service	**10 Marks**	**L2**	**CO3**
	b.	An electric locomotive uses a DC series motor with the following specifications Armature resistance, $R_a=0.1\ \Omega$ Supply voltage, $V_a=600$ V Back EMF at full speed, $E_b=500$ V Speed at the start of braking: $N=1000$rpm	**10 Marks**	**L3**	**CO4**

		Motor constant, k=0.02 Nm/A T During plugging (reverse-voltage) braking, the armature voltage is reversed and the back EMF decreases to Eb=300v E=300V due to reduced speed. Determine: i. The armature current during plugging braking ii. The braking torque generated during plugging torque constant, kT=0.1 Nm/A			

17.	**a.**	Apply the principles of train dynamics to explain how changes in acceleration, braking retardation, gradients, and train load influence the specific energy consumption. Use these factors to illustrate how operational decisions impact overall energy usage.	**10 Marks**	**L2**	**CO5**
	b.	Imagine you are an engineer evaluating whether a locomotive has enough traction to haul a 400-tonne train up a 3% gradient. The train is subjected to a rolling resistance of 35 N/t and must achieve an acceleration of 0.5 m/s^2. If the locomotive's wheels can generate tractive effort based on a coefficient of adhesion of 0.3, calculate the minimum locomotive weight required to provide the necessary tractive force safely.	**10 Marks**	**L3**	**CO5**

Or

18.	**a.**	Imagine you are part of a design team evaluating the performance of a new electric locomotive for a metropolitan rail system. To ensure the locomotive meets the required operational standards, you must analyze how tractive effort, power, and speed are related during train movement. Explain this relationship, and discuss how the coefficient of adhesion limits the maximum tractive effort the locomotive can safely develop.	**10 Marks**	**L2**	**CO5**
	b.	A train with a mass of 450 tons completes a 60 km trip consisting of three phases: Acceleration phase (20 km): 2500 kWh consumed Cruising phase (30 km): 3000 kWh consumed Braking phase (10 km): 800 kWh consumed, with 50% of the braking energy recovered Using this information, calculate the train's specific energy output	**10 Marks**	**L3**	**CO5**