

MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

**MECHATRONICS TECHNICIAN LEVEL 6/ MECHANICAL PLANT & MECHANICAL
PRODUCTION TECHNICIAN LEVEL 6**

APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES

UNIT CODE: UNIT CODE: ENG/OS/MC/CC/04/6/A

MARCH /APRIL 2024

INSTRUCTIONS TO THE CANDIDATE:

**THIS PAPER CONSIST TWO SECTIONS. A& B, ATTEMPT ALL THE
QUESTIONS IN SECTION A. ANSWER ANY THREE QUESTIONS IN SECTION B.**

TIME:3 HOURS.

Section A (40 MARKS)

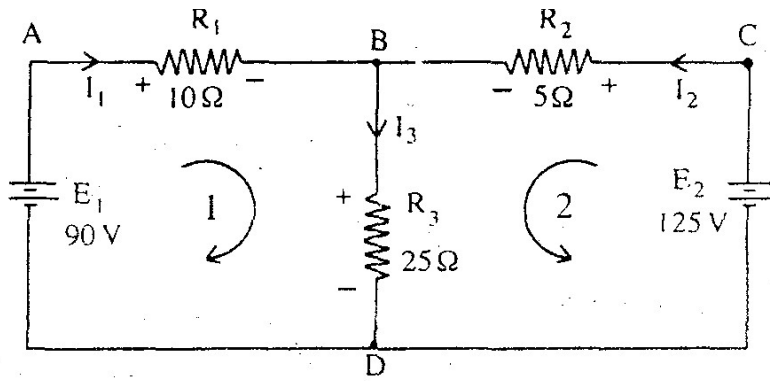
Answer ALL questions in this section.

1. State Ohm's law and list 2 limitations of Ohm's law. (3 marks)
2. List 3 power rectification methods. (3 marks)
3. For any closed loop the sum of voltages will be equal to? (1 mark)
4. Using a sketch graph distinguish between an alternating current and a direct current (4 marks)
5. State 4 applications of DC motors. (4 marks)
6. If a current of 5A flows for 2minutes, find the quantity of electricity transferred. (3 marks)
7. Define the following quantities and state their SI units. (2 marks)
 - I. Resistance
 - II. Voltage
8. List 2 limitations of superpositions theorem (2 marks)
9. a) Define the power factor (1 mark)
b) A 3-phase motor consumes 4.8kw when the line voltage is 220v and the line current is 15.4 A. What is the power factor? (3 marks)
10. Calculate the power utilized if a machine requires a force of 100N to move it a distance of 20m in 15 seconds. (3 marks)
11. a) Define earthing and state its use in electrical installation. (3 marks)
b) Identify 3 earthing types (3 marks)
12. Discuss 5 steps involved in testing earthing in electrical installations (5 marks)

SECTION B

Answer any *three* questions in this section

13. a) Distinguish Kirchhoff's first law and Kirchhoff's second law. (3 marks)
b) Calculate the current supplied by two batteries in the circuit given below.
[Using Kirchhoff's laws, find the values of I_1 , I_2 , I_3] (7 marks)



- c) Given $V_1=10$ volts, $V_2=5$ volts, $R=2$ ohms use superpositions theorem to find the voltage across resistor R (4 marks)
- d) State Norton's theorem and Thevenin's theorem (3 marks)
- e) How is Norton's theorem similar to Thevenin's theorem?(3 marks)
14. a) Discuss 4 ways in which motors are utilized in industrial machinery. (8 marks)
- b) List 3 characteristics of Single-Phase AC Motors and Three-Phase AC Motors. (6 marks)
- c) Given DC motor with the following properties; Voltage (V) = 48 V,
Current (I) = 2 A, Armature Resistance (R) = 2 Ω , Motor Constant (K) = 0.1
- I. Calculate the Power (3 marks)
 - II. Calculate the Torque (T);(3 marks)
[Assuming N (speed) is 1200 RPM]
15. a) Explain 5 types of lightning strokes. (10 marks)
- b) What measures should be taken to protect against over voltages in an electrical system within a lightning-prone area? (10 marks)
16. a) Explain the concept of power in electrical circuits as well the formula for calculating power. (2marks)
- b) A portable machine requires a force of 200N to move it. How much work is done if the machine is moved 20m and what average power is utilized if the movement takes 25s? (5 marks)
- c) Define the following terms as used in electrical circuits. (6 marks)
- I. Branch
 - II. Node
 - III. Loop
 - IV. Mesh

V. Active elements

VI. Passive elements

d) An electric heater consumes 1.8Mj when connected to a 250 V supply for 30 minutes. Find the power rating of the heater and the current taken from the supply. (3 marks)

e) A mass of 1000kg is raised through a height of 10m in 20s. What is
(I) the work done (2 marks) and (II) the power developed? (2 marks)