



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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UNIVERSITY EXAMINATIONS 2023/2024

FIRST YEAR, SECOND SEMESTER, EXAMINATION FOR DIPLOMA IN MECHATRONIC TECHNICIAN LEVEL 6, MECHANICAL PLANT, ELECTRICAL TECHNICIAN & MECHANICAL PRODUCTION TECHNICIAN LEVEL 6

ENG/OS/MC/CC/04/6/A: APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES/ ELECTRICAL AND ELECTRONICS PRINCIPLES

DATE: APRIL 2024

TIME: 3 HOURS

INSTRUCTIONS: Answer Question ONE and any other Three questions.

QUESTION ONE (40 MARKS)

1. State Ohm's law and list two limitations of Ohm's law. (3 Marks)
2. List three 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 two 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)



MUST is ISO 9001:2015 and

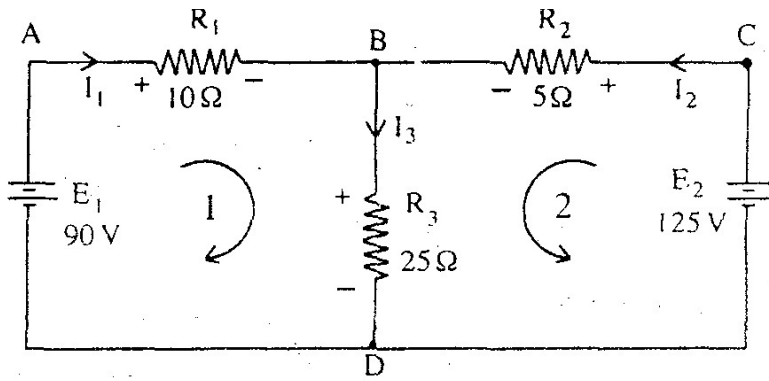


ISO/IEC 27001:2013 CERTIFIED

11. a) Define earthing and state its use in electrical installation. (3 Marks)
b) Identify three earthing types. (3 Marks)
12. Distinguish between single phase and three phase AC transformers. (3 Marks)
13. List two types of passive elements. (2 Marks)

SECTION B (60 MARKS)

14. a. Explain the concept of power in electrical circuits as well the formula for calculating power. (2 Marks)
- 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)
- Branch
 - Node
 - Loop
 - Mesh
 - Active elements
 - 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
- the work done (2 Marks)
 - the power developed? (2 Marks)
15. 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 is similar to Thevenin's theorem? (3 Marks)

16. a. Discuss four ways in which motors are utilized in industrial machinery. (8 Marks)

b. List three 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]

17. a. Explain five 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)