

071606T4AMT

AUTOMOTIVE MECHATRONICS TECHNOLOGY LEVEL 6

ENG/OS/AMT/CC/08/6/A

APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES

July/Aug 2023



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN

TEST

Time

INSTRUCTIONS TO CANDIDATE

1. This paper consists of **TWO** sections; A and B
2. Attempt **ALL** questions in section **A** and any **THREE** questions in section **B**.
3. Marks for each question are indicated in brackets ().
4. You are provided with a separate answer booklet.
5. Do not write on the question paper.

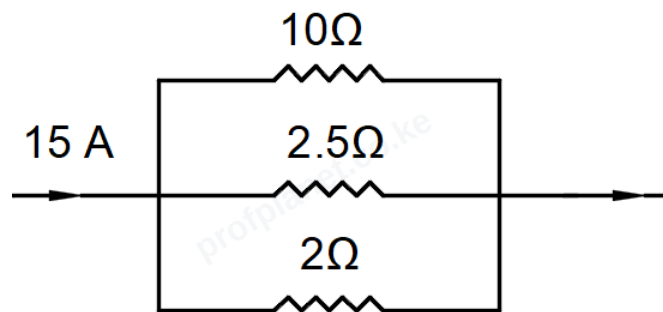
This paper consists of SIX (6) printed pages.

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

Turn over

SECTION A: (40 MARKS)*Attempt ALL questions in this section.*

1. Define electrical power and state its unit. (3 Marks)
2. State the superposition theorem. (2 Marks)
3. Outline any **four** types of lightening arrestors. (4 Marks)
4. Figure 1 shows a parallel connection of resistors in a D.C circuit. Calculate the voltage across the circuit and the current in the 10Ω resistor. (5 Marks)

**Figure 1**

5. With reference to the construction of D.C generators, state any **four** essential parts (4 Marks)
6. Match the components in Table 1 with their correct application (4 Marks)

Table 1

Component	Application
Thyristor	Power regulation and switching
Photodiode	Control electric power and current
TRIAC	Fire and smoke detection
Light Emitting diode (LED)	Illumination of objects

7. A capacitor of $20\mu\text{F}$ charged to 500V is connected in parallel with another of $10\mu\text{F}$ capacitance charged to 200 V . Calculate the loss of energy. (4 Marks)
8. Outline any **four** types of logic gates (4 Marks)
9. Electricity is recognized as a serious workplace hazard. State **two** protective equipment designed to protect workers from general and specific electrical hazards. (2 Marks)
- 10.
- a) State the function of a transformer in electrical circuits (2 Marks)
- b) Draw the electrical symbol for a transformer (2 Marks)
11. Calculate the resistance of a 2 km length overhead power cable if the cross-sectional area of the cable is 100 mm^2 .
Take the resistivity of aluminum to be $0.03 \times 10^{-6}\ \Omega\text{m}$. (4 Marks)

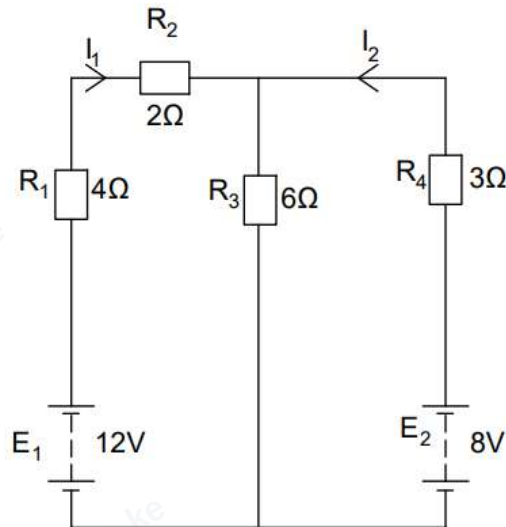
SECTION B: (60 MARKS)***Attempt any THREE questions in this section***

12.

- a) Explain the term speed regulation in D.C motors. (2 Marks)
- b) D.C generators are usually classified according to the way in which their fields are excited. State the **four** categories of D.C generators based on this classification. (4 Marks)
- c) A 220V D.C machine has an armature resistance of 0.5Ω . if the full load armature current is 20A, determine the induced e.m.f when the machine acts as
- i. Generator (4 Marks)
 - ii. Motor (4 Marks)
- d) A 6-pole generator has a lap-wound 40 slots with 20 conductors per slot. The flux per pole is 25 mWb. Calculate the speed at which the machine must be driven to generate an e.m.f. of 300V. (6 Marks)

13.

- a) State the following Kirchhoff's laws.
- i. Current law (2 Marks)
 - ii. Voltage law (2 Marks)
- b) With the aid of a diagram, illustrate the effects of temperature on resistance. (5 Marks)
- c) The figure below shows an electric circuit.



Using Kirchhoff's laws determine the:

- Current in each branch (5 Marks)
- Power dissipated by the 6 (3 Marks)
- Energy absorbed by the 3 minutes (3 Marks)

14. .

- Sketch the R-C filter circuit diagram smoothing circuit. (2 Marks)

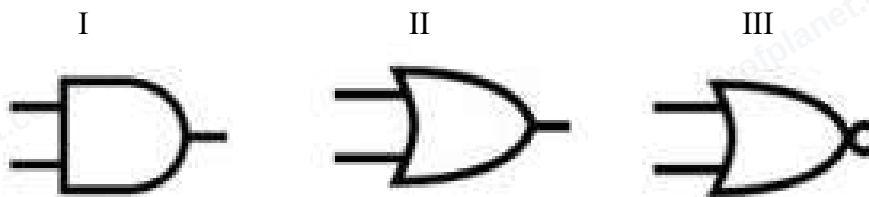
- Explain the following terms: (6 Marks)

- Rectification
- Voltage regulation
- Voltage multi pliers

- With the aid of a diagram, explain how full-wave rectification is obtained using a Centre-tapped transformer. (12 Marks)

15. .

- Identify the following types of logic gates (3 Marks)



b) Using Truth tables, represent the following logic gates. (4 Marks)

i. OR gate

ii. AND gate (4 Marks)

c) A 5 kVA single-phase transformer has a turns ratio of 10:1 and is fed from a 2.5 kV supply. Neglecting losses, determine:

i. The full-load secondary current (3 Marks)

ii. The minimum load resistance which can be connected across the secondary winding to give full load kVA. (3 Marks)

iii. The primary current at full load kVA. (3 Marks)