

071305T4EIN

ELECTRICAL INSTALLATION LEVEL 5

ENG/OS/ET/CC/03/5/A

Apply Electrical Principles

July/August 2024

Time: 3 HOURS



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

WRITTEN ASSESSMENT

3 HOURS

INSTRUCTIONS TO CANDIDATES

1. This paper consists of two sections: **A and B**.
2. You are provided with a separate answer booklet.
3. Marks for each question are as indicated.
4. Do not write on the question paper.

This paper consists of five (5) printed pages

**Check the question paper to ascertain that all pages are printed as indicated and that no
questions are missing**

SECTION A (40 MARKS)

Answer ALL questions in this section

- Faraday's law of electromagnetic induction is a fundamental principle of electromagnetism which forms the basis for many electrical devices such as transformers, inductors, and generators. State this law. (2 marks)
- Figure 1 shows a component installed for an electrical machine. Explain the importance of this component when installing electrical machines in industrial setup. (3 marks)

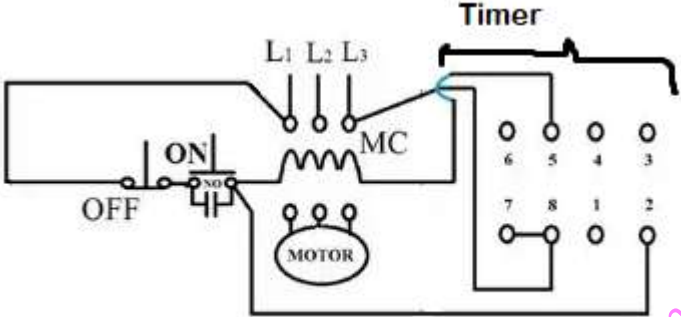


Figure 1

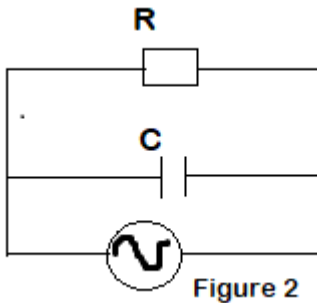
- Table 1 shows different electrical quantities, SI unit and definitions. Fill the table with the right unit and description. (4 marks)

Electrical quantity	SI unit	Description
Power	Rate at which electrical energy is transferred
Capacitance	Farad
.....	Henry	Property of a conductor to oppose changes in current by inducing a voltage.
Current	Ampere

Table 1

- Single-phase electrical machines are widely used in residential, commercial, and some industrial applications which are typically powered by single-phase AC power sources. List **four** types of Single phase machines which can be found in a training workshop. (4 marks)
- A d.c motor utilizes the interaction between a magnetic field and electric current to produce rotational force. State **three** main methods of controlling the speed of a d.c motor. (3 marks)

6. A $20\mu\text{F}$ capacitor is connected in series with a $50\text{k}\Omega$ resistor and the circuit is connected to a 20V d.c supply. Determine:
- The initial value of the current flowing
 - The time constant of the circuit
 - The value of current one second after connection (5 marks)
7. Figure 2 shows a resistor R and capacitor C connected across a.c voltage source. State **four** applications of capacitor in an A.C circuits. (4 marks)

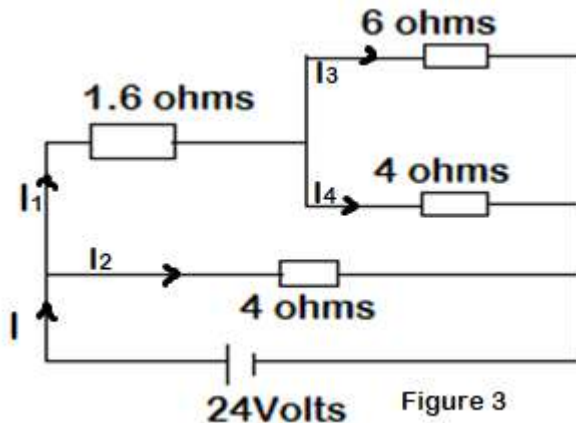


8. Magnetic fields are invisible areas of influence created by moving electric charges. They exert a force on other moving electric charges, magnetic materials, and even other magnetic fields. Outline **three** main sources of magnetic fields. (3 marks)
9. The study of electric charges at rest and the forces, fields, and potentials associated with them is known as electrostatics. What is the meaning of the terms below associated with electrostatics? (4 marks)
- Capacitance (C)
 - Electric flux density
10. A 5 kVA single-phase transformer has a turn's ratio of $10:1$ and is fed from a 2.5 kV supply. Neglecting losses, determine the full load secondary current. (5 marks)
11. Transformers experience various types of losses when they are under load which impact the efficiency and performance of the transformer. Outline **three** primary losses that occur in a transformer on load. (3 marks)

SECTION B (60 MARKS)

Answer **three** questions in this section

12. (a) Figure 3 shows a d.c circuit with four resistors connected to a 24 voltage supply. Using the circuit; Determine:



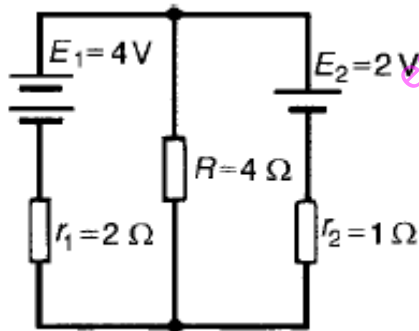
- i. Total resistance of the circuit. (4 marks)
 - ii. Power dissipated by a 1.6 Ω resistor. (4 marks)
 - iii. Energy through 6 Ω resistor after 2 minutes (4 marks)
- b) Basic electrical instruments are essential for measuring various electrical quantities and ensuring accurate and reliable data in electrical engineering and related fields. Outline **four** instrument and respective basic electrical quantities they can measure. (8 marks)
13. (a) Earthing of electrical systems is crucial in any electrical installation as outlined in I.E.E regulations. What is the meaning of the term earthing? (2 marks)
- b) Grounding is a critical safety measure in electrical systems and equipment. Explain **three** importance for connecting electrical systems to ground. (6 marks)
- c) Using a well labelled diagram, describe **three** methods that can be used to achieve earthing of an installation. (12 marks)
14. (a) Lightning protection systems are designed to safeguard structures and their occupants from the destructive effects of lightning strikes by providing a controlled path for the lightning current to travel to the ground. Outline **five** main components of a lightning protection system. (5 marks)

- b) Power factor refers to the efficiency of how electrical energy is used. A perfect power factor of 1.0 indicates all the delivered energy is used for actual work, while a lower power factor signifies wasted energy. Explain **three** causes of low Power Factor. (6 marks)
- c) (i) Power factor correction equipment aims to improve the power factor, reducing energy wastage and offering several benefits. State **three** Power Factor Improvement equipment. (3 marks)
- ii) A low power factor in electrical systems can lead to various disadvantages, affecting both operational efficiency and economic performance. List any **three** disadvantages. (3 marks)

15. (a) State;

- i. Superposition theorem. (2 marks)
- ii. Kirchhoff's laws (4 marks)

- b) The figure below shows a circuit diagram with two voltage sources. Use Kirchhoff's laws to determine the currents flowing in each branch of the network. (10 marks)



- c) Derive the resonant frequency in R-L-C series circuit given that $f_r = 1/2\pi\sqrt{LC}$ (4 marks)

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