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071305T4EOP

ELECTRICAL OPERATION (POWER OPTION) LEVEL 5

ENG/OS/PO/CC/01/5

APPLY ELECTRICAL PRINCIPLES

July/August 2024

Time: 3 Hours

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

WRITTEN ASSESSMENT

TIME 3 HOURS

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INSTRUCTIONS TO CANDIDATES:

1. This paper has two sections: **A** and **B**
2. Answer **all** questions in section A and **three** questions in section B.
3. You are provided with a separate answer booklet.
4. Marks for each question are as indicated.
5. Do not write on the question paper.
6. Answer the questions in **English**.

This tool consists of FIVE (5) printed pages

Candidates should 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*

1. Ohm's law is crucial in analyzing and designing electrical circuits and determining the behavior of components. State Ohm's law as used in electrical and electronics principles. (2 marks)
2. Draw the resistor voltage (V) against time(S) characteristic curve for charging a capacitor. (2 marks)
3. The choice of electrical instruments used to measure current depends on factors like the type of current being measured, the range of current expected, and the accessibility of the circuit. List **two** electrical instrument you would use to measure current in an electric circuit. (2 marks)
4. A charge of 240 Coulombs is transferred in 2 minutes in an electric circuit, what is the amount of current flowing through it? (3 marks)
5. Units are fundamental in measurements, state what abbreviation 'SI units' stands for. (1 mark)
6. When current passes through a resistor, power is usually dissipated in terms of heat. What is the power dissipated by a resistor of 10 Ω when a current of 2 A passes through it? (2 marks)
7. A current of 2 A flows for 10 h through a 100 resistor. What is the energy consumed by the resistor? (3 marks)
8. A solar PV system is composed of various parts. Name the **four** major components of a solar PV system. (4 marks)
9. An EMF of 50V is applied in turn to the following resistors. Calculate the current that flows in each case:
   a) 22 Ω
   b) 820 Ω
   c) 330kΩ (6 marks)
10. Phases of a three-phase supply system can be interconnected to reduce the number of conductors used compared with three single-phase systems. State **two** ways in which this can be done. (2 marks)

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11. Phase and line currents and voltages have a common relationship in a star connected system. Show the relationships. (2 marks)
12. Power in a three-phase system can be measured using different methods. State **three** methods. (3 marks)
13. Fuses are used in protecting circuits. Define the meaning of the following terms with reference to fuses:
    a) Current rating of a fuse
    b) Fusing current (4 marks)
14. The figure below shows a D.C. network. determine the current flowing in the 5Ω resistor by using Norton's theorem: (4 marks)

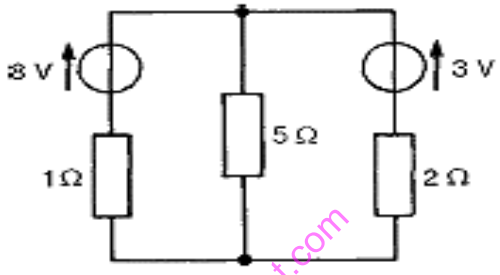


Figure 1

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SECTION B (60 MARKS)

*Answer any **THREE** questions in this section.*

15. a) Maintaining high power factor is very fundamental in electrical engineering.

i. State the causes of low power factors (6 marks)

ii. Which are the ways used to improve the power factor of a system? (6 marks)

b) A 230 V supply feeds three 1.84 kW loads with power factors of 1, 0.8 and 0.4. Calculate the current at each power factor.

i. Current at 1.0 power factor.

ii. Current at 0.8 power factor.

iii. Current at 0.8 power factor**.**

iv. Justify the results in (i),(ii),(iii) (8 marks)

16. a) It is a requirement for all electrical systems to be earthed.

i. State **three** reasons for earthing. (3 marks)

ii. Explain **three** methods that can be used to achieve earthing of an installation (6 marks)

iii. State **two** tests related to earthing that should be carried out in a completed electrical installation. (4 marks)

iv. What are the components of lightning protection system? (4 marks)

b) Different structures of air termination or termination network are used in buildings. State **three** structures commonly used in buildings (3 marks)

17. a) Draw a well labelled diagram of a DC machine (6 marks)

b) Using a well labelled diagram, explain the construction and operation of Single-phase capacitor start motors and their phasor representation. (8 marks)

c) Explain the transformer losses under two general headings:

i. Copper losses

ii. Iron losses. (6 marks)

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18. a) 200 kg of ice at – 10^{o} C is placed in a bunker to cool some vegetables. 24 hours later the ice has melted into water at 5^{0} C. What is the average rate of cooling in kJ/hr and TR provided by the ice? (10 marks)

    b) A refrigeration system produces 40 kg/hr of ice at 0oC from water at 25^{o}C. Find the refrigeration effect per hour and TR. If it consumes 1 kW of energy to produce the ice, find the COP. Take latent heat of solidification of water at 0oC as 335 kJ/kg and specific heat of water 4.19 kJ/kg ^{o}C. (10 marks)

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