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TELECOMMUNICATION ENGINEERING LEVEL 6

ENG/OS/TLE/CC/02/6/A

APPLY ELECTRICAL PRINCIPLES

July/August 2024



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

WRITTEN ASSESSMENT

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INSTRUCTIONS TO CANDIDATES

The paper consists of TWO sections; A & B

You are provided with a separate answer booklet

Marks for each question are as indicated

Do not write on the question paper

This paper consists FOUR printed pages.

**Candidate 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 from this section.

1. In electrical engineering, earthing of an electrical equipment is a standard requirement. Define the term earthing and state TWO reasons for earthing. [4 marks]
2. Work done and average power developed by a machine depends on the force applied. A portable machine requires a force of 400N to move it. [4 marks]
 - a) How much work is done if the machine is moved 10 Meters?
 - b) Calculate the average power utilized, if the movement takes 20 Seconds.
3. Electric circuits can be built from resistors arranged in parallel, series or a combination of both. Figure 1 shows an electric circuit.

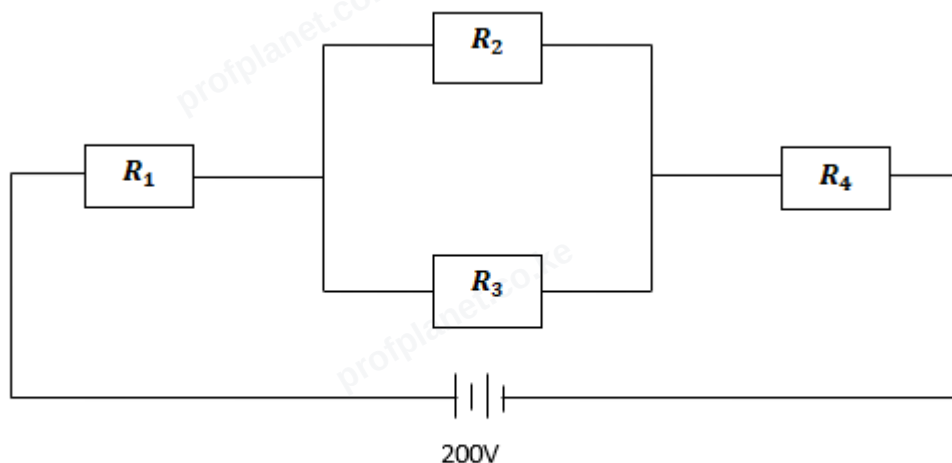


Figure 1

Given the following values; $R_1 = 2.5 \Omega$, $R_2 = 6 \Omega$, $R_3 = 2 \Omega$ and $R_4 = 4 \Omega$,

Determine the:

- a) Total circuit resistance; [1 marks]
 - b) Supply current; [1 marks]
 - c) Current flowing through R_2 and R_3 resistors. [2 marks]
4. Transformers are used in electrical power distribution to step up and step down, as well as in electronic circuits for coupling multistages. Briefly explain why transformers are rated in KVA [2 marks]
 5. Lightning is a sudden electrostatic discharge that occurs during a thunderstorm. This discharge occurs between electrically charged regions of a cloud, between two clouds, or between a cloud and the ground. State TWO effects of lightning. [2 marks]

6. Electromagnetic waves have distinctive properties that distinguish them from other waves. List FOUR properties of electromagnetic waves [4 marks]
7. The desired power factor is unity. A power factor less than unity results into several disadvantages. State any FOUR disadvantages of low power factor. [4 marks]
8. Transient refers to a temporary condition or state that occurs during the transition from one steady-state condition to another. A 1.0 H choke has a resistance of 50 ohms. This choke is supplied with an a.c voltage of $e=141\sin 314t$. Find the expression for the transient component of the current flowing through the choke after the voltage is suddenly switched on. [4 marks]
9. Passive networks are widely used in various applications such as filtering, impedance matching and digital or analog signal processing. Briefly explain the meaning of passive network. [2 marks]
10. Inductance is the property of a circuit to oppose further change in current. An inductive coil stores energy in the form of a magnetic field. State TWO factors affecting inductance of a coil. [2 marks]
11. The Poynting theorem is used to understand the flow of electromagnetic energy in various systems, including communication transmission lines and electromagnetic wave propagation. State the Poynting theorem as applied in energy conservation. [3 marks]
12. An alternator is an electrical device that converts mechanical energy into electrical energy. An alternator is supplying a load of 300 kW at a P.F of 0.6 lagging. If the power factor is raised to unity, how many more kilowatts can alternator supply for the same kVA load? [5 marks]

SECTION B [60 MARKS]

Answer any **THREE** questions in this section

13.

- a) Static capacitors are used for power factor improvement in factories due to many advantages they have over other power factor improvement equipment. Outline FOUR reasons why static capacitors are popular in power factor correction. [8 marks]

- b) An industrial load consists of ;
- i. A synchronous motor of 100 metric h.p
 - ii. Induction motors of 200 metric h.p, 0.707 power factor lagging and 82% efficiency
 - iii. Lighting load of 30 kW.

The tariff is Ksh 100 per annum per kVA on maximum demand plus 6 cents per kWh. Find the annual cost of the synchronous motor operates at 0.8 P.F leading, 93% efficiency and 0.8 P.F lagging at 93% efficiency.

[12 marks]

14.

- a) Three similar coils, each having resistance of 8Ω and an inductive reactance of 8Ω are connected across a 415V, 3-phase supply. Calculate for each of the following connections the readings on each of the two wattmeters connected to measure the power by the two-wattmeter method. [8 marks]

- i. In Star
- ii. In Delta

- b) A series RLC circuit containing a resistance of 12Ω , an inductance of 0.15H and a capacitance of 100 μ F are connected in series across a 100V, 50Hz supply. Calculate the total circuit impedance, the circuit's current, power factor and draw the voltage phasor diagram. [12 marks]

15.

- a) State Kirchhoff's laws. [4 marks]

- b) Figure 2 shows an electric circuit. Determine the branch currents in the circuit using the Kirchhoff's current law. [12 marks]

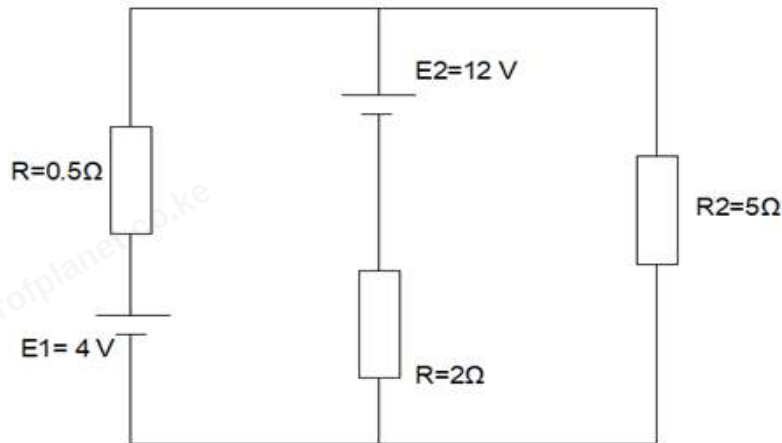


Figure 2

- c) The resistance of copper wire, 40M in length and having a resistivity of $0.002 \times 10^{-6} \Omega\text{m}$ is 0.25Ω . Determine the radius of the wire. [4 marks]
- 16.

- a) An alternating voltage is $(200\pi t - 0.25)$ volts. Find the following; [12 marks]

- i. Voltage amplitude
- ii. peak-to-peak voltage value
- iii. Vrms value
- iv. periodic time
- v. The frequency
- vi. phase angle (in degrees and minutes)

- b) A single-phase, 50Hz transformer has 25 primary turns and 300 secondary turns. The cross-sectional area of the core is 300 cm^2 . When the primary winding is connected to a 250V supply, determine the; [8 marks]

- i. Maximum value of the flux density in the core
- ii. Voltage induced in the secondary winding.

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