TEVETA

Technical Education, Vocational and Entrepreneurship Training Authority

DIPLOMA IN BIOMEDICAL ENGINEERING

LEVEL 6 YEAR 1 EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY/AUGUST 2025

SUBJECT: FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

PASS MARK: 50

INSTRUCTIONS TO CANDIDATE

1. Write your Examination number and National Registration Card (NRC) number on the answer booklet provided. Ensure you append your signature in the space provided on the answer booklet.
2. Write the ANSWER SCRIPT SERIAL NUMBER on the examination register and on the entry slip.
3. There are EIGHT (8) questions in this paper. Answer FIVE (5) questions.
4. Diagrams may be used where necessary to clarify your answer.
5. Cell phones and programmable calculators are not allowed in the examination room.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

QUESTION 1

a) Define the following terms in relation to Chemical effects of electricity:
   i) Electrolysis [2 marks]
   ii) Electrolyte [2 marks]
   iii) Electroplating [2 marks]
   iv) Corrosion [2 marks]

b) Explain the following terms:
   i) Polarization [4 marks]
   ii) Local action [4 marks]

c) A battery has eight cells, each with an internal resistance of 0.2 Ω and an e.m.f of 2.2 V. Determine the e.m.f and the internal resistance of the battery when cells are connected in:
   i) Series [2 marks]
   ii) Parallel [2 marks]

[TOTAL 20 MARKS]

QUESTION 2

a) Explain the following terms:
   i) Power triangle [5 marks]
   ii) Power factor [5 marks]

b) The power taken by an inductive circuit when connected to a 120 V, 50 Hz supply is 400 W and the current is 8 A. Calculate the:
   i) Resistance [2 marks]
   ii) Impedance [2 marks]
   iii) Reactance [2 marks]
   iv) Power factor [2 marks]
   v) Phase angle [2 marks]

[TOTAL 20 MARKS]

QUESTION 3

a) With the aid of diagrams, explain ways Power in three-phase loads may be measured using the following:
   i) Three Wattmeter method [3 marks]
   ii) Two Wattmeter method [3 marks]
   iii) One Wattmeter method [3 marks]

b) Each phase of a delta-connected load comprises a resistance of 30 Ω and an 80 μF capacitor in series. The load is connected to a 400 V, 50 Hz, 3-phase supply. Calculate the:
   i) Phase current [3 marks]
   ii) Line current [2 marks]
   iii) Total power dissipated [3 marks]
   iv) kVA rating of the load. [3 marks]

[TOTAL 20 MARKS]

QUESTION 4

a) Define the following terms:
   i) Real power [1 mark]
   ii) Reactive power [1 mark]

b) A 415 V, 3-phase a.c. motor has a power output of 12.75 kW and operates at a power factor of 0.77 lagging with an efficiency of 85%. If the motor is delta-connected, determine:
   i) The power input [4 marks]
   ii) The line current [3 marks]
   iii) The phase current. [3 marks]

c) Two wattmeters indicate 10 kW and 3 kW respectively when connected to measure the input power to a 3-phase balanced load, the reverse switch being operated on the meter indicating the 3 kW reading. Determine:
   i) the input power [4 marks]
   ii) the load power factor [4 marks]

[TOTAL 20 MARKS]

QUESTION 5

a) With the aid of the diagram, describe the operation of the NPN transistor. [4 marks]
b) Draw the block diagram of a regulated dc power supply. [6 marks]
c) Explain the operation of the Zener diode as a voltage regulator. [10 marks]

[TOTAL 20 MARKS]

QUESTION 6

a) Define the Q-factor of a circuit. [4 marks]
b) A coil of negligible resistance and inductance of 100 mH is connected in series with a 2 μF capacitor and a 10 Ω resistor across a 50 V, variable frequency supply. Determine the:
   i) Resonance frequency [4 marks]
   ii) Current at resonance [4 marks]
   iii) Voltage across the coil at resonance [2 marks]
   iv) Voltage across the capacitor at resonance [2 marks]
   v) Q-factor of the circuit. [4 marks]

[TOTAL 20 MARKS]

QUESTION 7

a) The resistance of a conductor 1 mm^2 in cross section and 20 m long is 0.346 Ω. Determine the specific resistance of the material. [4 marks]
b) State **four (4)** characteristics of resistors connected in series and parallel circuits. [8 marks]
c) For the circuit given in Figure Q7, calculate the:
   i) Current in all the resistors. [4 marks]
   ii) Supply voltage. [4marks]

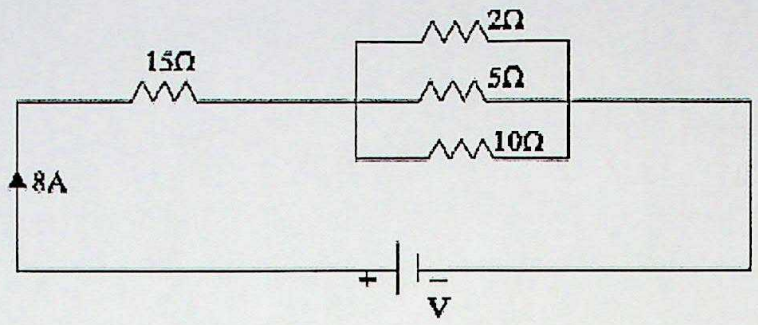


Figure Q7: Resistive network

[TOTAL 20 MARKS]

QUESTION 8

a) In relation to electric circuit analysis techniques, define the following.
   i) Nodes. [2 marks]
   ii) Branch. [2 marks]
   iii) Closed Loop. [2 marks]

b) For the given network in Figure Q8, apply KVL to calculate the:
   i) Branch current in the 8 Ω resistor [7 marks]
   ii) Voltage across the 3 Ω resistor [7 marks]

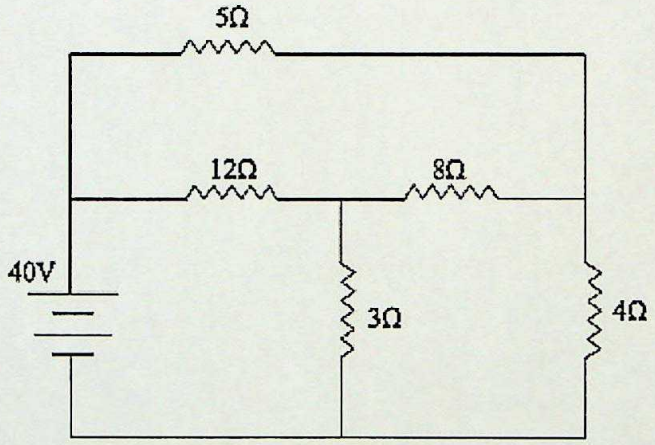


Figure Q8: Purely resistive circuit

[TOTAL 20 MARKS]