

DIPLOMA IN BIOMEDICAL ENGINEERING TECHNOLOGY

LEVEL 6 YEAR I EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY/AUGUST 2025

SUBJECT: ELECTRICAL FUNDAMENTALS (THEORY)

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 5 hp, single-phase motor with a 0.6 p.f lagging and an efficiency of 92% is connected to a 208 V, and 60 Hz supply.

a) Establish the power triangle for the load. [5 marks]
b) Determine the power factor that must be placed in parallel with the load to raise the power factor to unity. [3 marks]
c) Determine the change in supply current from the uncompensated to compensated system. [3 marks]
d) Find the network equivalent of the above. [9 marks]

[TOTAL MARKS 20]

QUESTION 2

a) State Thevenin's theorem. [2 marks]
b) Use the Thevenin's theorem to determine the power displaced by the 3 Ω in the network of Figure Q2 (b). [6 marks]

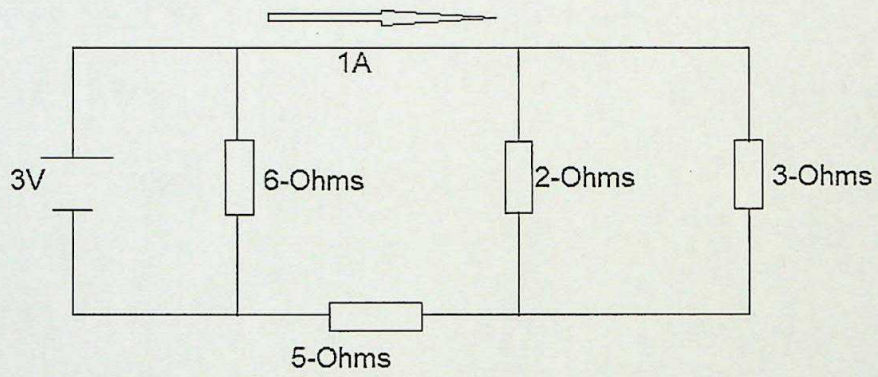


Figure Q2 (b): Thevenin's equivalent circuit

c) Illustrate the answers in (b) with well labelled diagrams and draw a Thevenin's equivalent circuit. [6 marks]
d) Transform a Wye (Y) configuration in Figure Q2 (d) into a delta configuration. [6 marks]

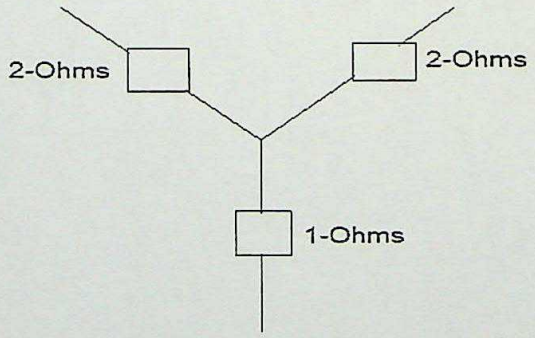


Figure Q2 (d): Wye (Y) configuration

[TOTAL MARKS 20]

QUESTION 3

a) Three impedances, each of impedance Z = (**5 - j2**) Ω are connected in delta across a three-phase supply whose line voltage is 110 V. Determine the:

i) Voltage across each impedance [3marks]

ii) Line current drawn from the supply [3marks]

iii) Power factor [4marks]

b) Convert the delta network in Figure Q3 to an equivalent star network. [10 marks]

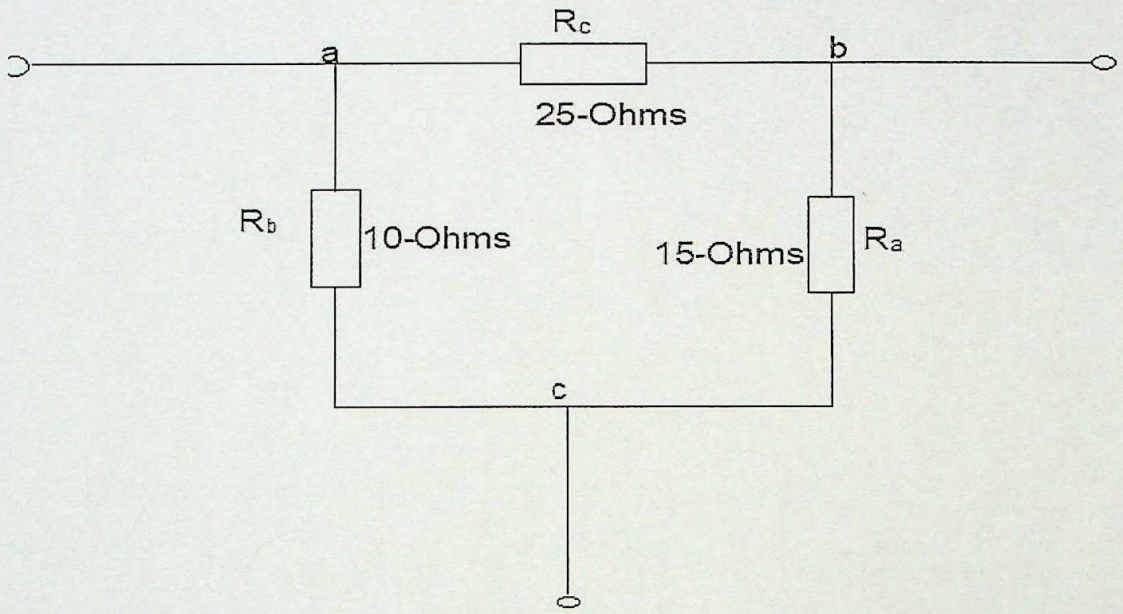


Figure Q3: Delta network

[TOTAL MARKS 20]

QUESTION 4

a) A three-phase load takes a line current of 10 A at 0.8 power factor lagging from a supply whose line voltage is 415 V. Determine the:

i) Power taken by the load [5 marks]

ii) Weekly energy cost of operating the load for eight hours a day, six days a week if the energy charge is 7.5 ngwee per unit. [5marks]

b) Two watt-meters are connected to measure the power input to a 400 V, 50 Hz, three-phase motor running on full load with an efficiency of 90%. The readings on the two watt-meters are 30 kW and 10 kW respectively. Calculate the:

i) Input power to the motor [5 marks]

ii) Power factor [5 marks]

[TOTAL MARKS 20]

QUESTION 5

a) Describe, with the aid of a diagram, the production of three-phase voltages in an electric generator. [10 marks]

b) Explain the reasons for the common use of a star connection for power distribution purposes in Zambia today. [5 marks]

c) Explain, with the aid of a diagram, the meaning of **'phase sequence'** as applied to three phase systems. [5 marks]

[TOTAL MARKS 20]

QUESTION 6

a) Define the Q-factor of a coil or circuit. [2 marks]

b) A coil having an inductance of 200 μH and a resistance of 50 Ω is connected in parallel with a capacitor of capacitance of 120 μF to a 100 V supply. Determine the:

i) Dynamic impedance of the circuit [4 marks]

ii) Q-factor of the circuit [4 marks]

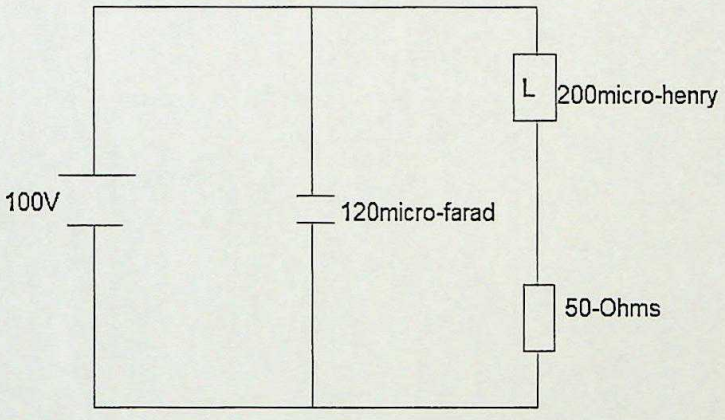


Figure Q6: DC Circuit

c) A d.c. voltage of 200 V is suddenly applied to a circuit consisting of a resistor of 20 Ω resistance in series with an inductor having an inductance of 0.5 H. Determine the:

i) Time constant of the circuit [5 marks]

ii) Final steady state value of the circuit [5 marks]

[TOTAL MARKS 20]

QUESTION 7

Four cells, each of e.m.f 1.5 V and internal resistance 0.5 Ω, are connected in parallel across an external resistance of 2.5 Ω, determine the:

a) Current supplied by the battery [5 marks]

b) Current supplied by each cell [5 marks]

c) Terminal voltage of the battery [10 marks]

[TOTAL MARKS 20]

QUESTION 8

An alternating current of frequency 60 Hz has a maximum value of 120 A.

a) Derive the equation for the instantaneous value of current. [5 marks]

b) Considering the time from the instant current is zero to the moment it becomes positive, find the instantaneous value after 1/360 seconds. [10 marks]

c) Calculate the time taken to reach 96 A for the first time. [5 marks]

[TOTAL MARKS 20]

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