NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

BSC HONOURS IN CIVIL AND WATER ENGINEERING: PART I

PRINCIPLES OF ELECTRICAL ENGINEERING: TCW 1104

Supplementary Examination Paper:

August 2024

This examination paper consists of 5 pages.

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Scientific calculator

Examiner's Name: Mr R Baloyi

INSTRUCTIONS

ANSWER ALL PARTS OF QUESTION 1 IN SECTION A AND ANY THREE QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS

MARK ALLOCATION

QUESTION	MARKS
1.	**40**
2.	**20**
3.	**20**
4.	**20**
5.	**20**
Maximum possible marks	**100**

Answer **all** parts of the section

Question 1

a) With the aid of relevant diagrams and waveforms describe the operation of the following

i. Half wave rectifier circuit [4]

ii. Bridge rectifier circuit [4]

b) State and describe any four dc voltage sources [8]

c) State any two limitations of Ohms law [2]

d) State Kirchoff's Laws in relation to both current (KCL) and voltage (KVL) [2]

e) Calculate the values of the currents I_a , I_b and I_c flowing through the resistors in **Fig 1** using the following methods

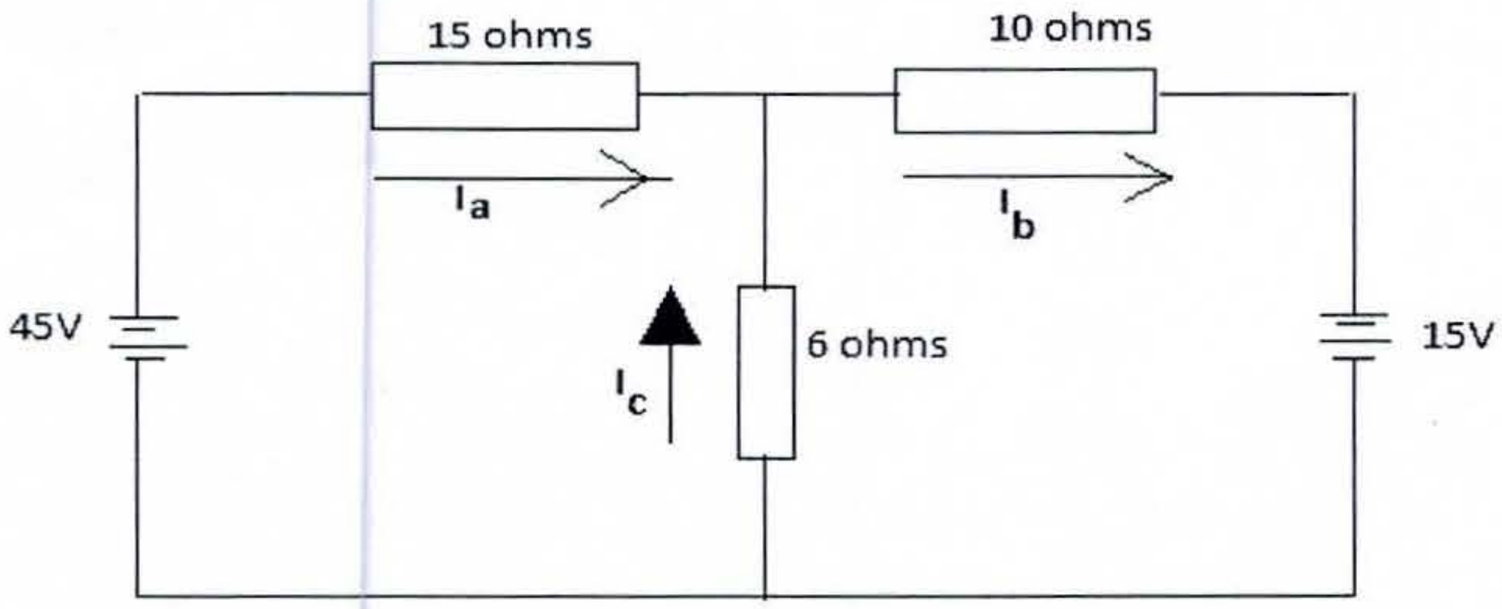

Fig 1

i. Kirchoff's laws [4]

ii. The mesh analysis [4]

iii. The method of superposition [4]

iv. Thevenin theorem [3]

f) Describe the operation of an **AND** logic gate by means of

i. Symbol as a logic function

ii. An equivalent circuit

iii. Truth table with its associated Boolean function

iv. Input and output square waveforms [5]

SECTION B

Answer any three questions from this section

Question 2

a) Define **Earthing** or **Grounding** with regards to complex building structures [2]

b) Explain the significance of Earthing a building to a construction engineer [4]

c) Describe factors affecting the earth's resistance [4]

d) Comment on the electrical properties of any eighty construction materials. Describe how each of the named construction materials can either contribute to an electrical shock or electrical hazards or either mitigate them [8]

e) The instantaneous value of an alternating current is given by **I= 10sin314.2t** amperes. For the a.c. current:

(i) calculate the frequency

(ii) calculate the periodic time [2]

Question 3

a) Describe the components of a **Power Supply Unit** using a relevant schematic diagram and explain the relevance of each component with the aid of waveforms in order to produce a desired output voltage [10]

b) As a civil and construction engineer describe any power distribution aspects which can be relevant for you to consider in the design and supervision of a construction project for a new infrastructure [4]

c) Identify any three electrical faults and how each one can be avoided [6]

Question 4

Study **Fig 2** and use it to answer the questions below

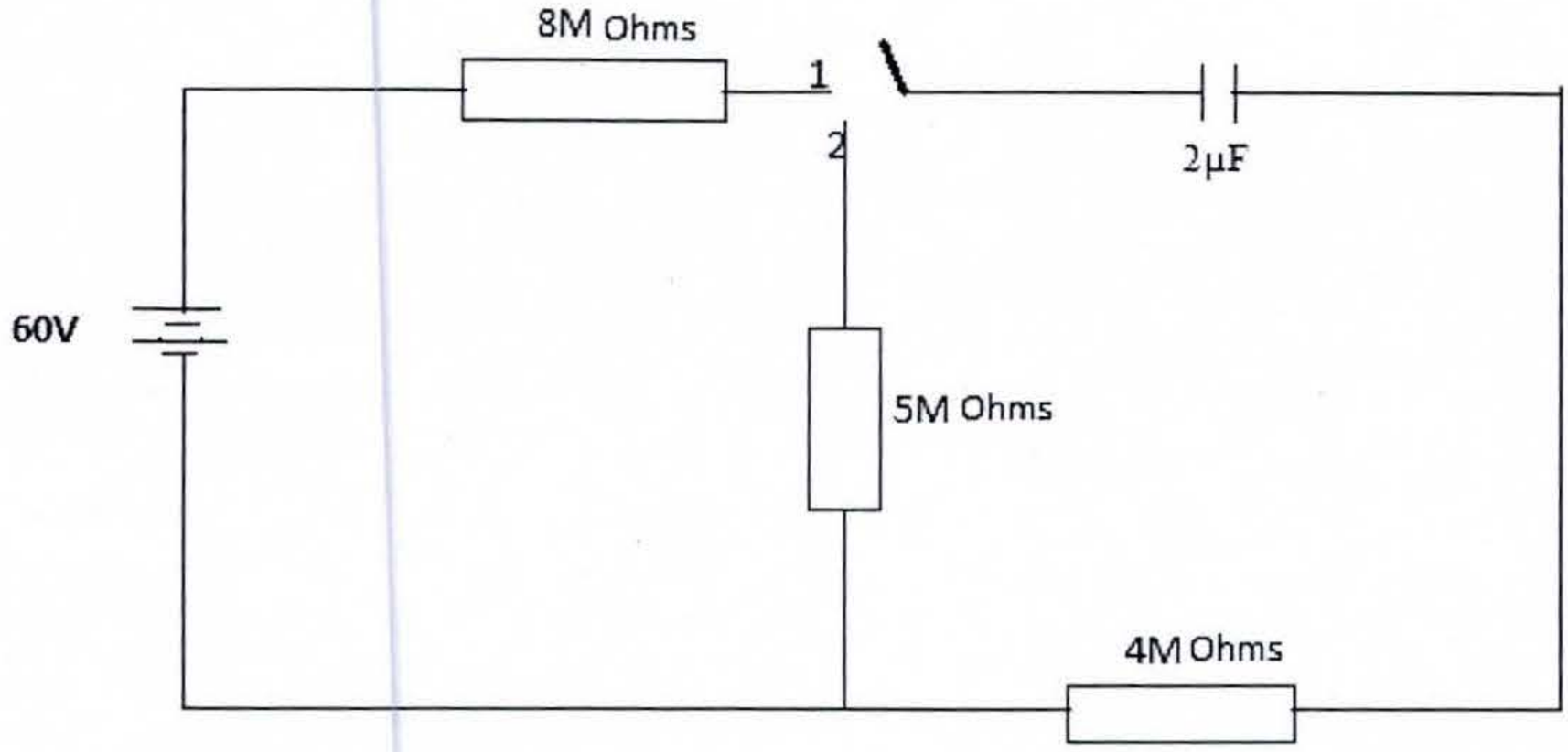

Fig 2

a) The switch S in the **Fig 2** above is switched to position 1 for 10 seconds.
Calculate the voltage across the capacitor after the first 10 second [3]

b) Immediately after 10seconds the switch is moved to position 2 for two minutes
Calculate the voltage drop across the capacitor after 6 seconds of discharging when the switch was moved to position 2. [3]

c) Construct a voltage against time graph for the voltage changes across the capacitor during the time period describes in part a) and b) [3]

d) Describe one danger associated with charging and discharging inductors. State one way in which this danger can give a positive benefit or application in real life [2]

e) A house has twelve 40W lights all of which run continuously for eight hours every day. The lights are all connected in series. The electricity supply is 220V.

I. Calculate the total current when all the lights are operating.

II. Determine the annual lighting bill for the house if 1kWh of electricity costs 15cent.

III. Calculate the yearly saving on the bill if the lights are replaced by energy-efficient CFL bulbs having the same light output but rated at 9W.
(Assume there are 365 days in a year) [5]

f) Describe any safety precautions to consider in the use and handling of electrical appliances [6]

Question 5

a) Describe the relevance of the following components in an electric circuit

i. Resistors

ii. LEDs

iii. Capacitors,

iv. Transistors

v. Heat Sinks [5]

b) Describe any physical checks and functionality tests you can carry out for the following components

i. Capacitors,

ii. switches,

iii. fuses [6]

c) describe any basic trouble shooting techniques for a device in an office which has suddenly stopped working [4]

d) Explain why it is a safety measure to switch off your cell phone when operating in an environment of electric and magnetic fields like MRI scanners [2]

e) Define the term **Magnetization** [1]

f) Describe any one method of magnetization [2]