NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONIC ENGINEERING

TEE 2292 Electrical Engineering Principles

Supplementary examinations

May 2024

This examination paper consists of 4 pages

Time Allowed: 3 Hours

Total Marks: 100

Examiner's Name: Eng. J.T. Mawanza

INSTRUCTION AND INFORMATION TO THE CANDIDATE

1. Answer ALL parts of Section A and any THREE questions from Section B.
2. Section A carries 40 marks and Section B carries 60 marks.
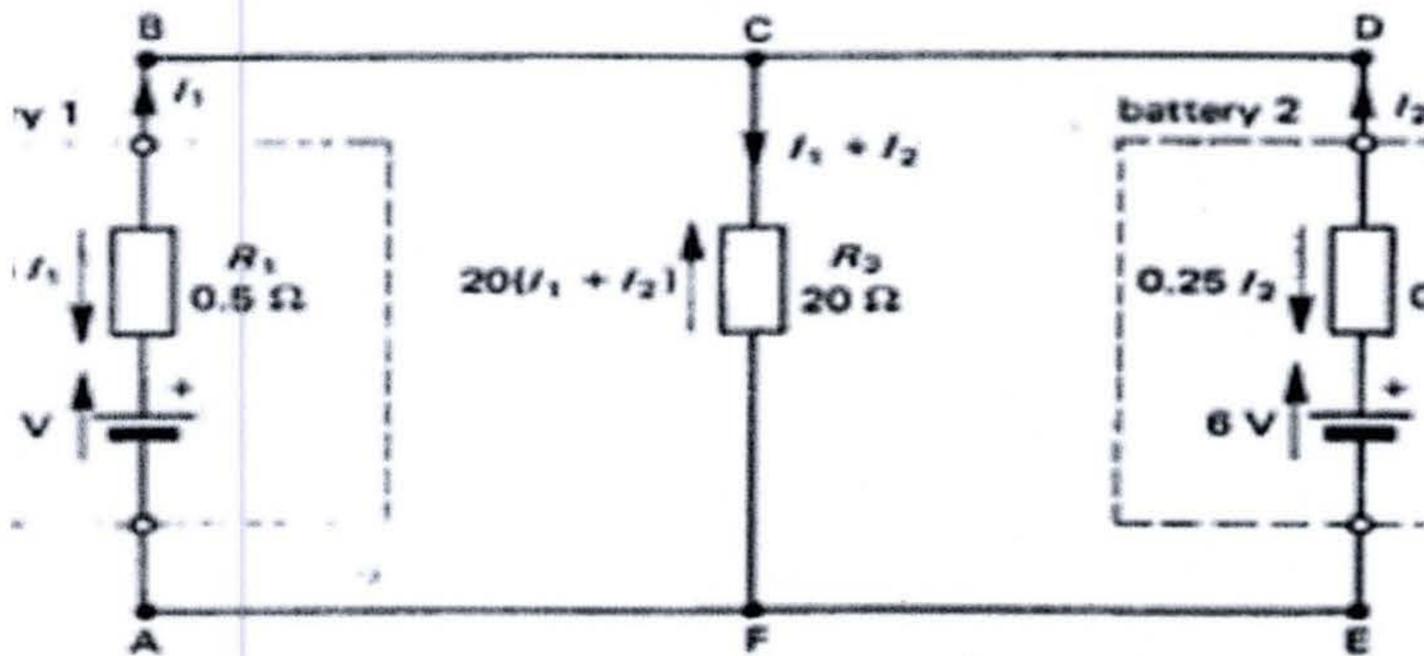3. Start each question on a new page
4. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1	40
2	20
3	20
4	20
5	20
Total marks attainable by candidate	100

SECTION A

Question 1

a) In the circuit below calculate the current in each of the resistors. If the values are given as follows: $R_1 = 10\Omega$, $R_1 = 20\Omega$, $R_3 = 30\Omega$, $V_1 = 15\,V$, $V_1 = 20\,V$. **[20 Marks]**

Question 2

a) With the aid of a diagram, explain the operation of one form of a single-phase AC motor.

[10 Marks]

b) Three resistors of 10 Ω, 20 Ω and 10 Ω are connected

  i. In series

  ii. in parallel

  The power consumed in an AC circuit containing a pure resistance is 200 W. If the supply voltage is 240 V, determine the current and resistance of the circuit.

[10 Marks]

SECTION B

Question 3

a) Under what circumstances are the following used: a three-phase 4-wire system and a three-phase 3-wire system. **[4 Marks]**

b) Explain the principle and operation of an induction motor and a synchronous motor in detail by drawing suitable diagrams. **[16 Marks]**

Question 4

a) Explain the terms:
   i. self-induction,
   ii. induction by motion,
   iii. mutual induction. **[12 Marks]**

b) An inductor has an inductive reactance of 10Ω at a frequency of 100Hz. Calculate the reactance of the inductor at a frequency of
   i. 50 Hz
   ii. 400 Hz
   iii. 1 500 Hz

If the supply voltage is 100 V rms, determine the current in the inductor for each frequency. **[8 Marks]**

Question 5

a) What is meant by: inductive reactance and capacitive reactance? Circuit A contains an inductance of reactance 150 Ω and circuit B contains a capacitance of reactance 80 Ω. If the supply voltage is 100V, calculate for each circuit the current in the circuit and the phase angle of the circuit. **[10 Marks]**

b) Draw 4 types of DC machines and give some applications for each of them. **[8 Marks]**

c) Calculate the mean value of a sinusoidal voltage wave whose maximum value is 100 V. Determine also the maximum value of a voltage wave whose average value is 90V. **[2 Marks]**

Question 6

a) Calculate the speed of the rotating field of a 2-pole motor in rev/min if the supply frequency is: 50Hz and 60Hz. What is the synchronous speed if the motor has 2 pole-pairs (two N poles and two S poles). **[8 Marks]**

b) Define the following active voltage, active current, reactive voltage, reactive current **[8 Marks]**

c) A 50Hz, four-pole induction motor has a fractional slip of 5%. Calculate the speed of the motor. **[4 Marks]**