# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

## DEPARTMENT OF ELECTRONIC ENGINEERING TEE

**2292 Electrical Engineering Principles**

**Supplementary Examinations**

**July 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**

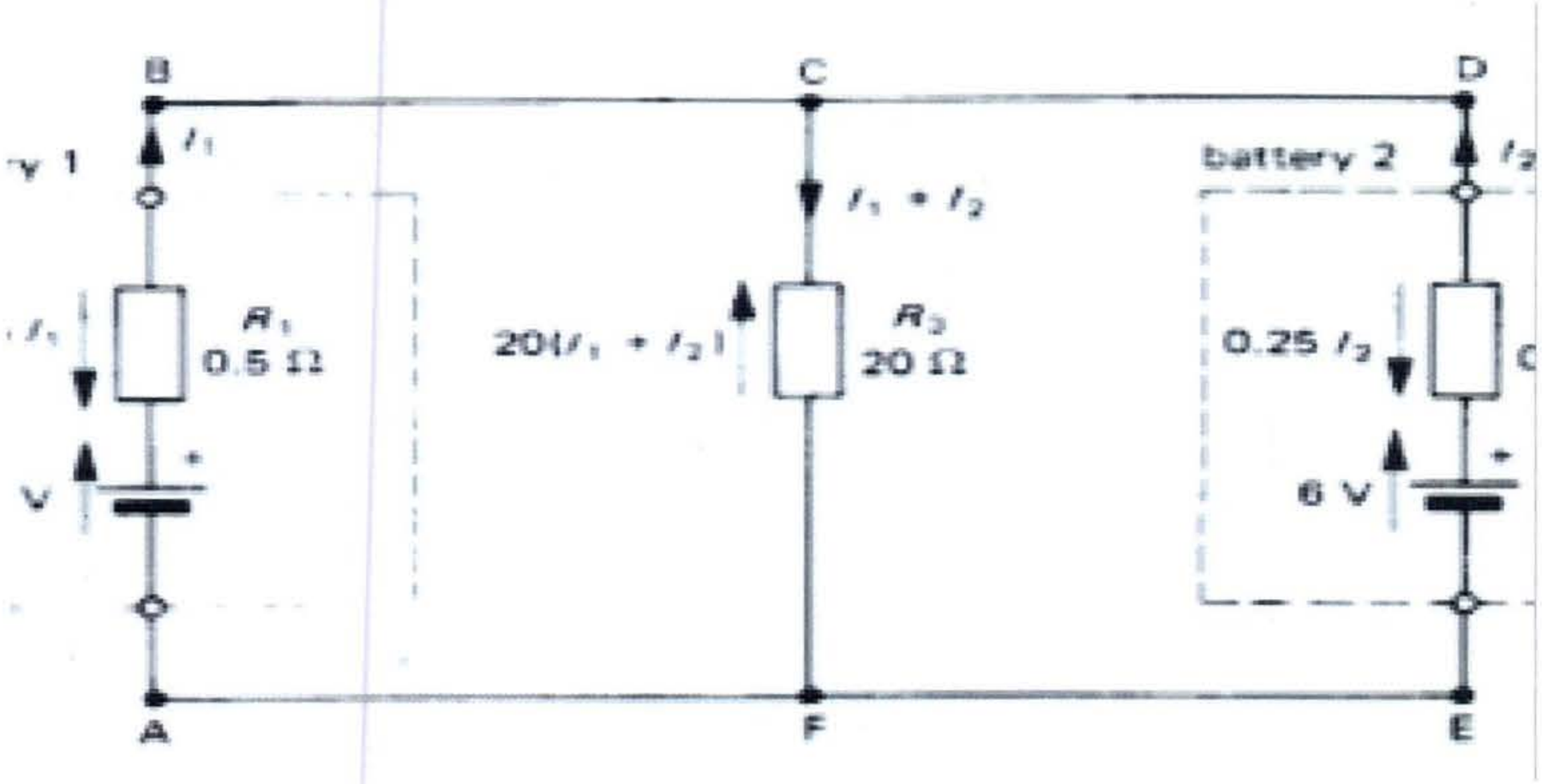
**MARK ALLOCATION**

| 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]**