MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2024/2025

FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE, COMPUTER TECHNOLOGY, MATHEMATICS AND COMPUTER SCIENCE AND BACHELOR OF EDUCATION SCIENCE WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

CIR 103: ELECTRICAL PRINCIPLES

Date: 31st January, 2025 Time: 3. 30 - 6. 30 pm

INSTRUCTIONS:

- DO NOT write anywhere on this question paper
- SECTION A: Question ONE is COMPULSORY.
- SECTION B: Question 2-5: Answer any TWO questions of your choice.

SECTION A {30 MARKS)

Q1. (a) State THREE principal sources of E.M.F. [3 marks]

(b) State Ohm's law [2 marks]

(c)The figure 1.1 below has a voltage supply of 12V. Using Ohms Law,

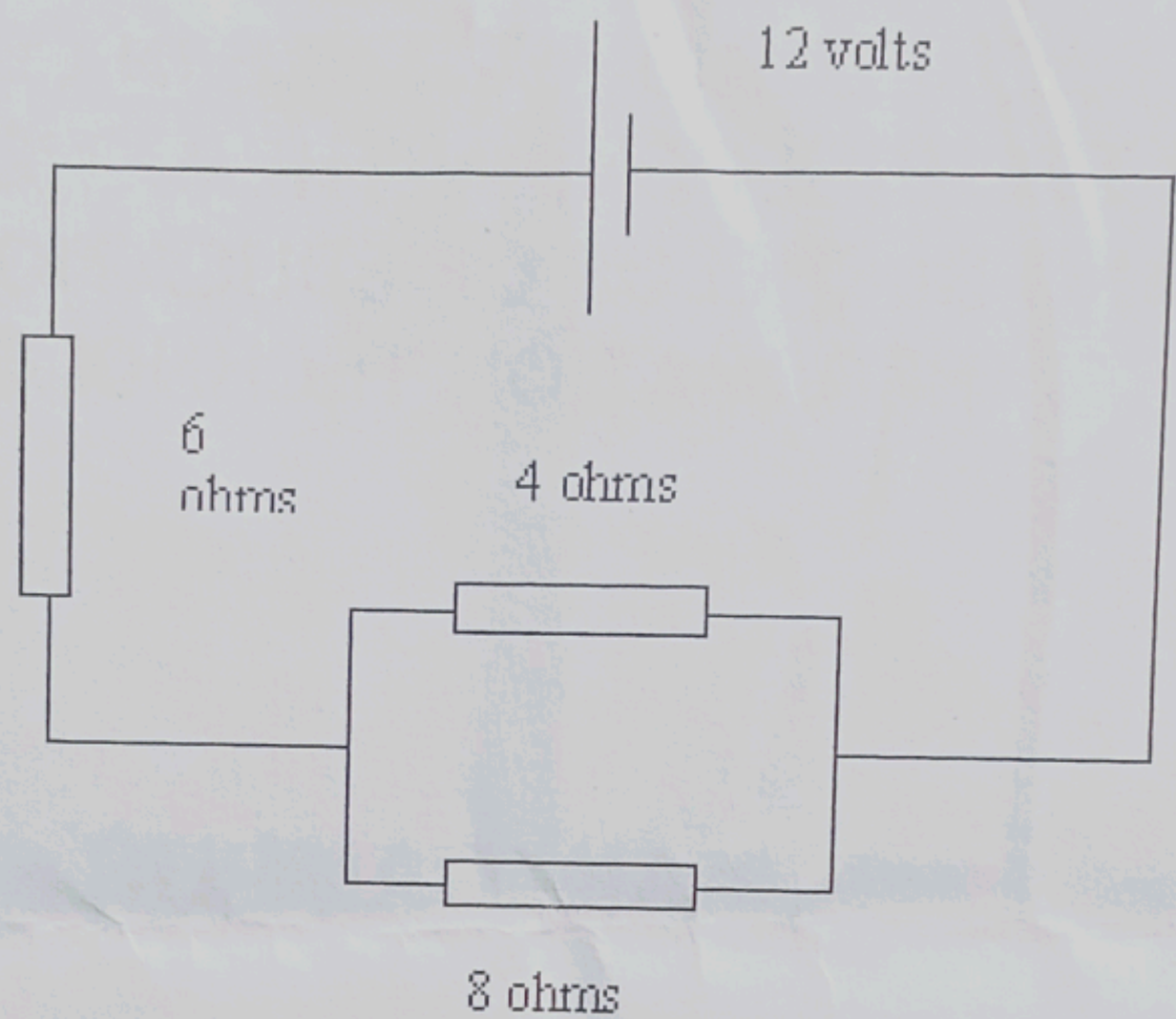

Figure 1.1

i. what is the single total circuit equivalent resistance? 3 marks
ii. what is the total current? 2 marks
iii. what is the voltage across the 6 ohm resistor? 3 marks
iv. what is the current in each resistor? 3 marks

(d) Determine the value of the four-band colour-coded resistor shown in figure 1.2 [2 marks]

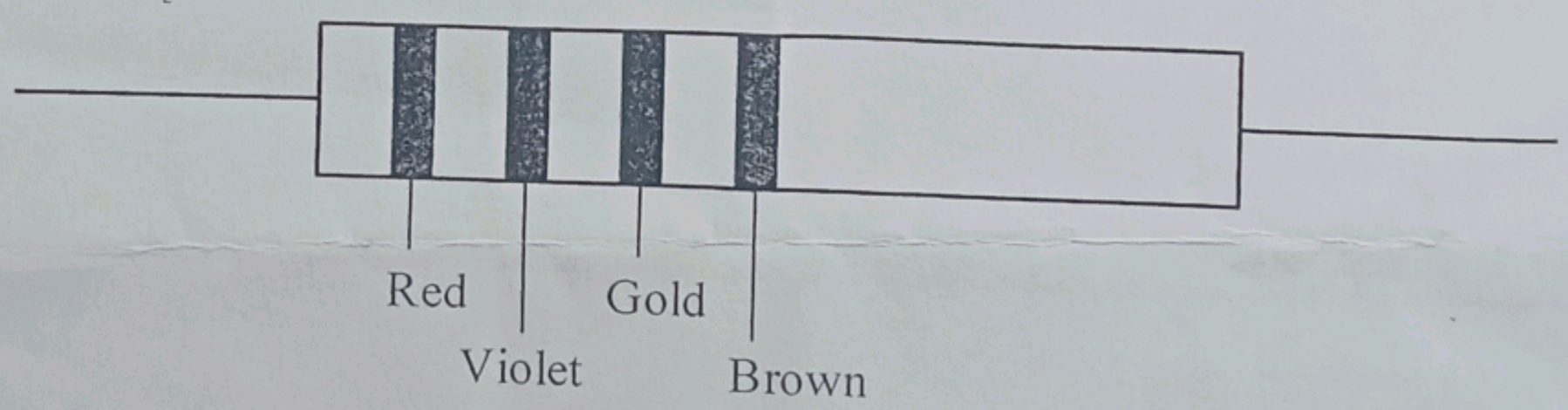

Figure 1.2

(e) State Kirchoff's

(i) Current law [2 marks]

(ii) Voltage law [2 marks]

A network is arranged as shown in figure 1.3.

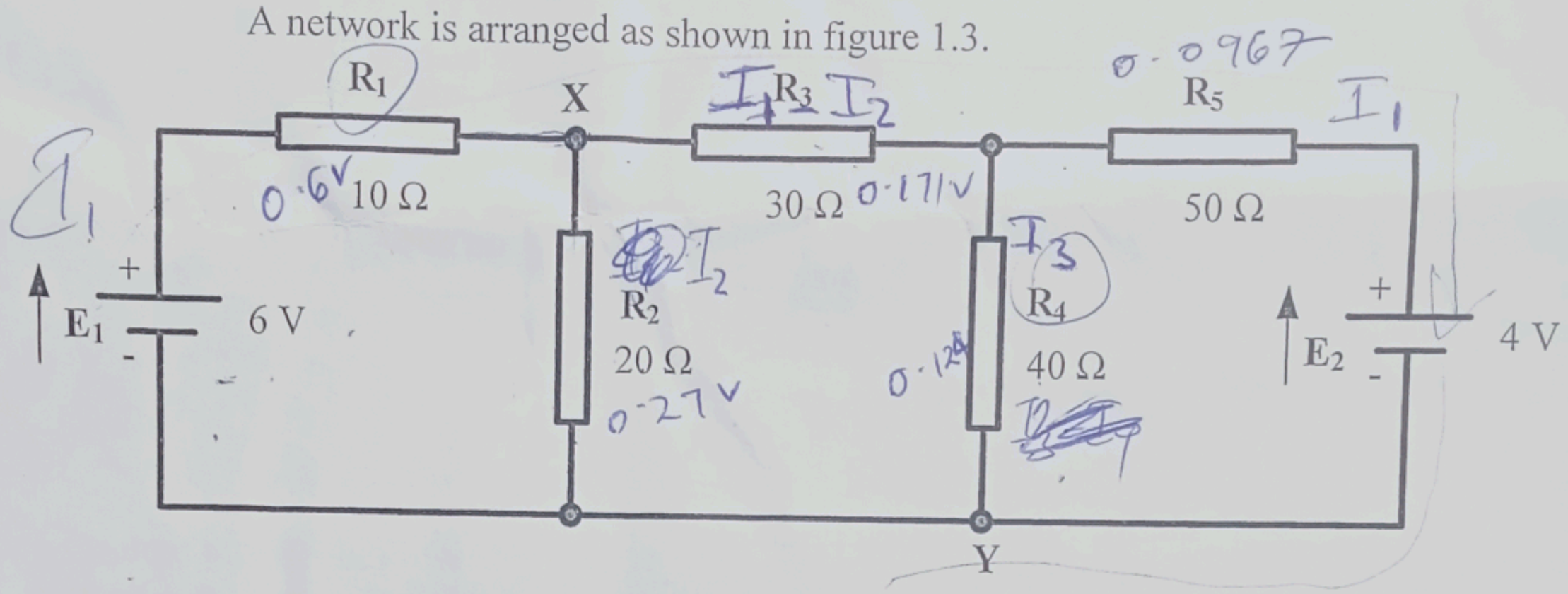

Figure 1.3

Using Kirchoff's laws, calculate

(i) Currents in resistors R_1 and R_4. [6marks]

(ii) P.d. of point X with respect to pint Y. [2 marks]

Show all your workings clearly.

SECTION B

{20 MARKS EACH}

Question Two 20 marks

a)Use loop analysis to find the current flowing in each branch of the figure 2.1 below..

[10mark]

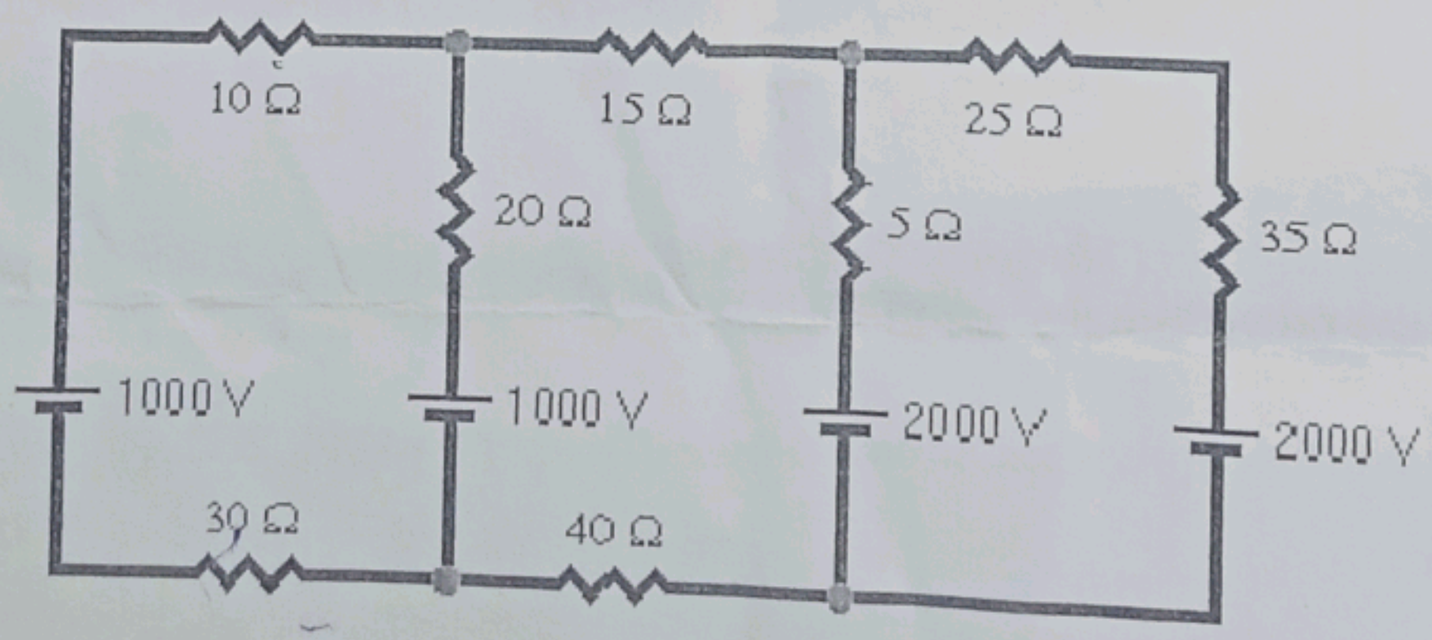

Figure 2.1

b) Use nodal analysis to find the voltage at each node of figure 2.2 below. [10marks]

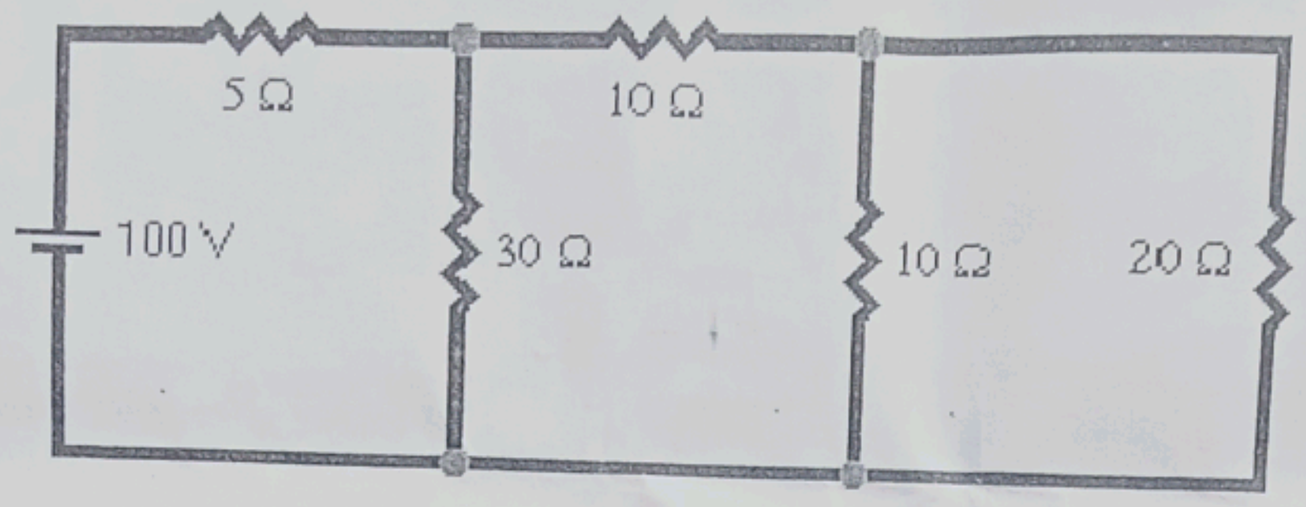

Figure 2.2

Question Three 20 marks

1. Define Superposition Principle. 4marks
2. Outline the steps to solve Superposition Theorem. 6marks
3. Use superposition principle to find the currents through all the resistors in the figure 3.1 below. [10marks]

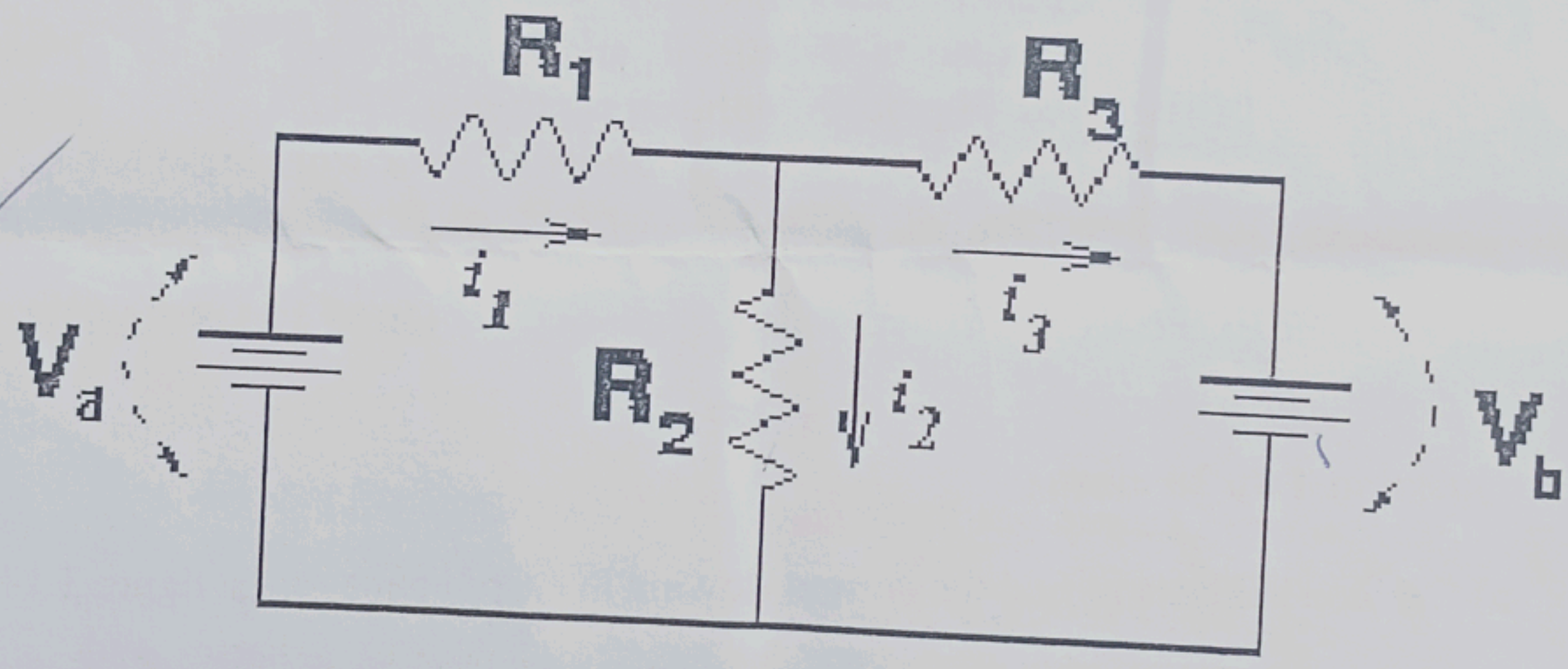

Figure 3.1

DATA: $V_a = 12$ V, $V_b = 12$ V, $R_1 = 10$ ohm, $R_2 = 15$ ohms, $R_3 = 20$ ohm

Question Four 20 marks

a) State Thevenin's and Norton's Theorems [4marks]
b) Outline the procedure (steps) to solve Thevenin's and Norton's Theorems. [6marks]
c) Find the Norton equivalent circuit for the figure 4.1 below. [6 marks]

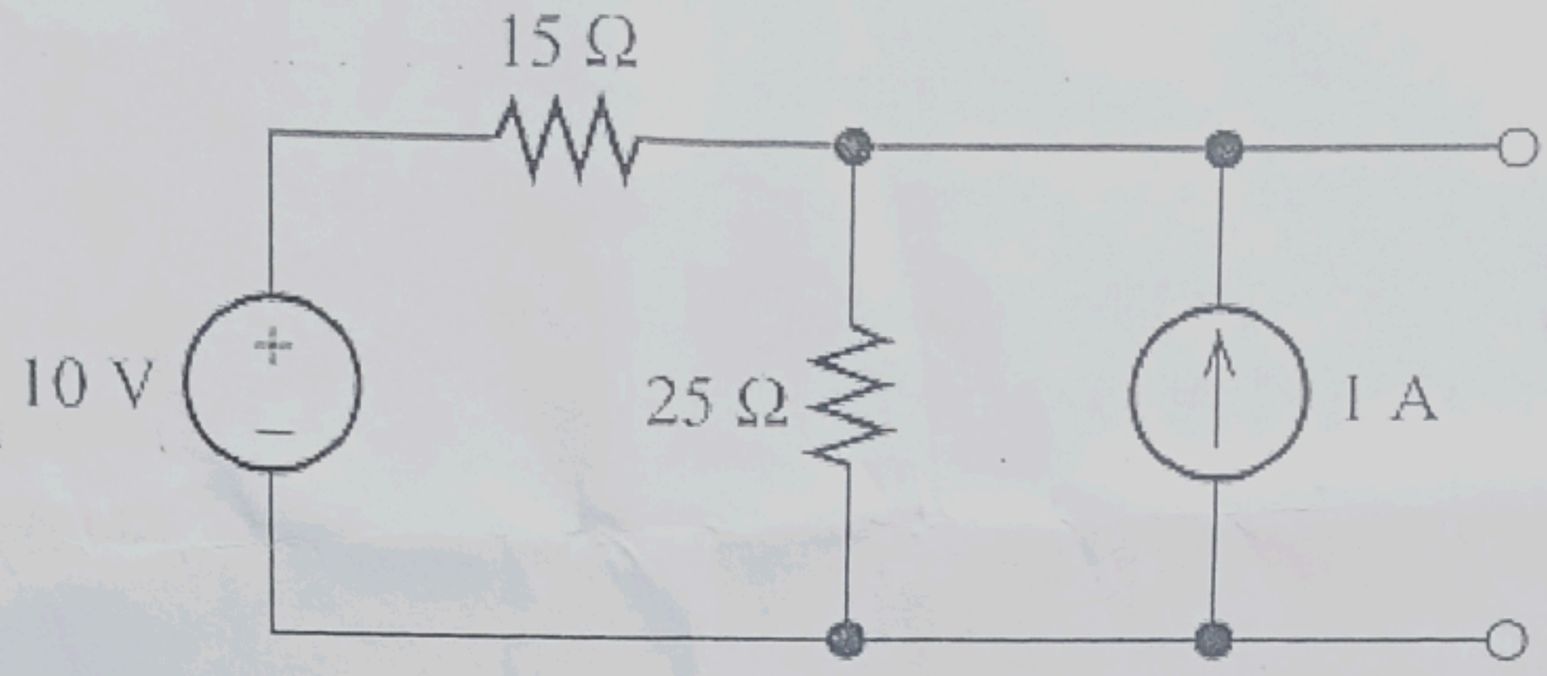

Figure 4.1

d) Define Maximum Power Transfer (MPT) in electrical circuits. How can we efficiently maximize the power transferred to a load? [4 marks]

Question Five (20 Marks)

It is desired that the total impedance Z_T of the RLC circuit in figure 5.1 below be a resistor of 50K ohms at resonance. Calculate the following parameters:

i. The value of the inductive reactance, X_L [5 marks]
ii. The value of the capacitive reactance, X_c [5 marks]
iii. Find the resonant frequency if the coil inductance is L = 16mH [5 marks]
iv. Find the value of the capacitor, C [5 marks]

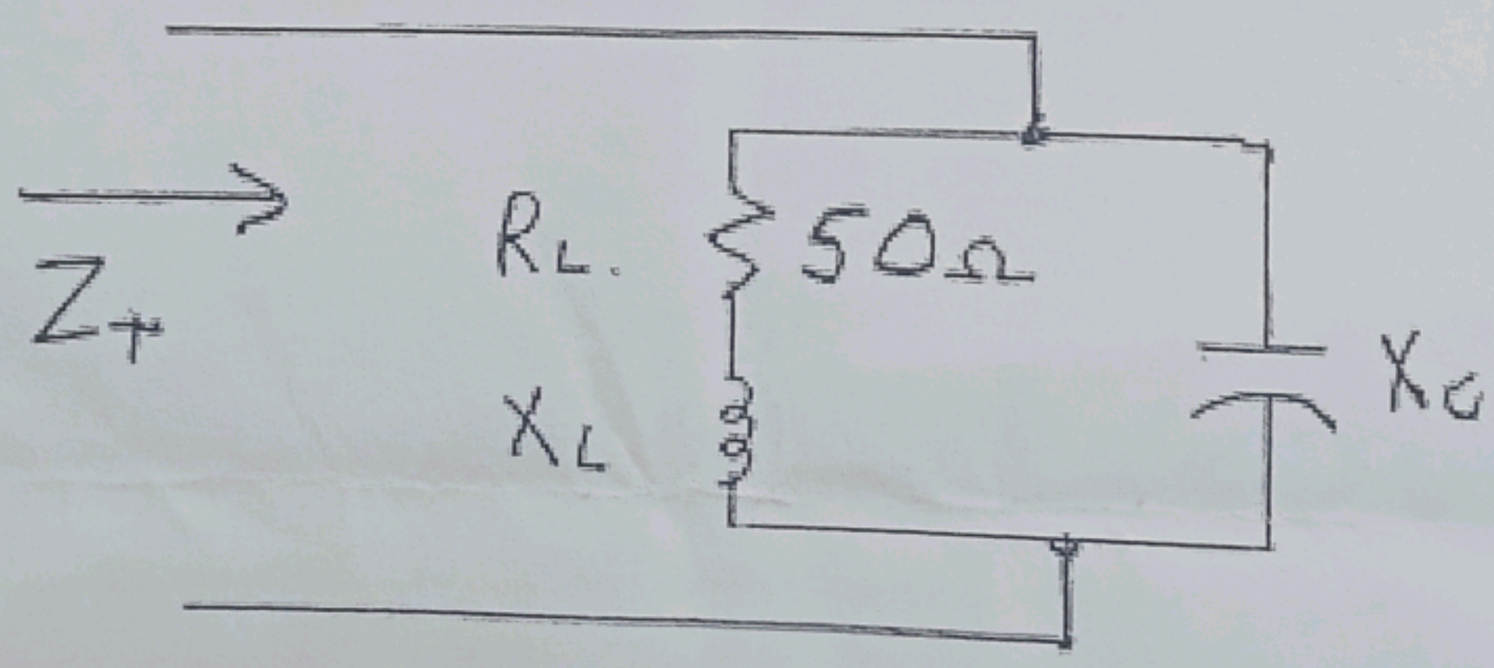

Figure 5.1

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FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE, COMPUTER TECHNOLOGY AND BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER

MAIN CAMPUS

CIR 103: ELECTRICAL PRINCIPLES

Date: 17th January, 2024 Time: 12.00 - 3.00pm

INSTRUCTIONS:

- Do not write anywhere on this Question paper
- Answer Question ONE and any other TWO.
- Diagrams, were required should be clearly drawn and fully labelled
- Mobile phones are PROHIBITED in examination room.

SECTION 1: Answer ALL questions in this section

Q1: 30 Marks

(a) An electric motor gives output power of 20 kW and operates with an efficiency of 80 %. If the constant input voltage to the motor is 200 V. what is the constant supply current? 2 marks

(b) (i) How does electrical resistance of a conductor vary with its length (l)and the area of cross-section(A)? 2 marks

(ii) A coil wound from a 10 m length of copper wire having a cross-sectional area of 1.0 mm^2 is found to have a resistance of 159 Ω. Determine its **resistivity, conductivity** and the **resistance** of 1 km length of the line. wire 3 marks

(c) A certain generator has an open-circuit voltage of 12 V and an internal resistance of 40Ω. Calculate:

(i) the load resistance for maximum power transfer. 1 mark

(ii) the corresponding values of the terminal voltage 2 marks

(iii) power supplied to the load, and 2 marks

(iv) efficiency of the power transfer. 2 marks

(d) If two capacitors having capacitances of 6 F and 10 F respectively are connected across a 200 V supply: in series.

(i) sketch the circuit; and find, 2 marks

(ii) the p.d across each capacitor 2 marks

(iii) the charge on each capacitor. 4 marks

(e) A 250 kVA, 11000 V / 400V, 50 Hz single-phase transformer has 80 turns on the secondary. Calculate:

(i) the approximate values of the primary and secondary currents 4 marks

(ii) the approximate number of primary turns 2 marks

(iii) the maximum value of the flux 2 marks

SECTION 2: Answer any TWO complete questions from this section

Q2 A portion of a residential service to a home is depicted in the diagram drawn below.

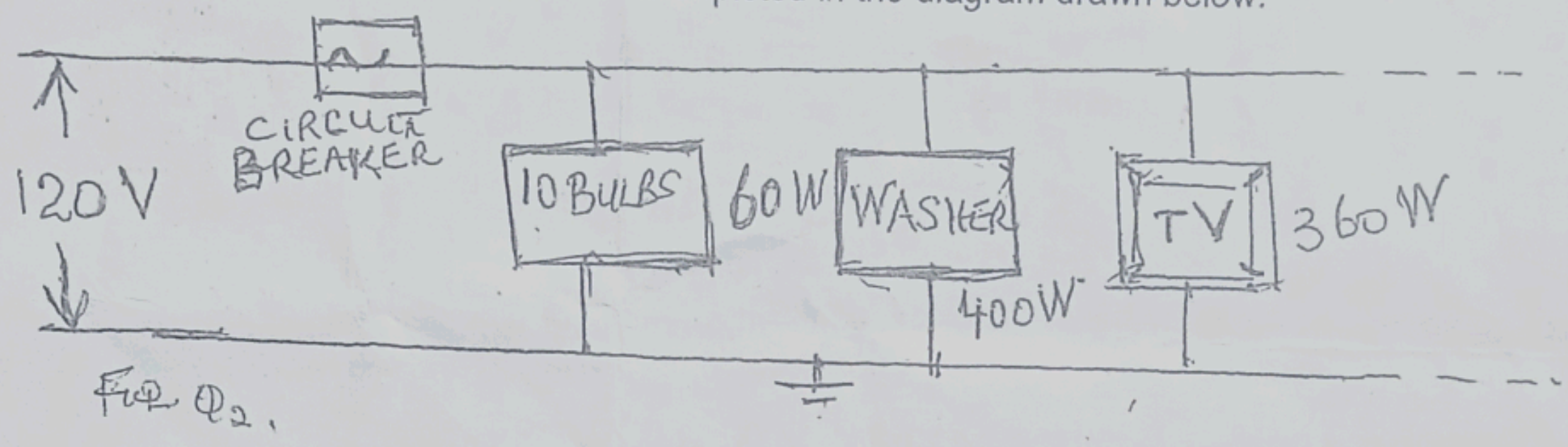


Fig. Q2.

(a) Explain the essence of the circuit breaker 2 marks

(b) Determine the current through each parallel branch of the network 6 marks

(c) Calculate the current drawn from the 120 V source, and determine whether the 20 A circuit breaker will trip or not. Give reasons for your answer 5 marks

(d) Investigate and comment on the effect on the network if the TV is disconnected (removed from the circuit) and other connections remain intact. 5 marks

(e) State one advantage and one disadvantage of connecting domestic appliances in parallel across the source supply? 2 mark

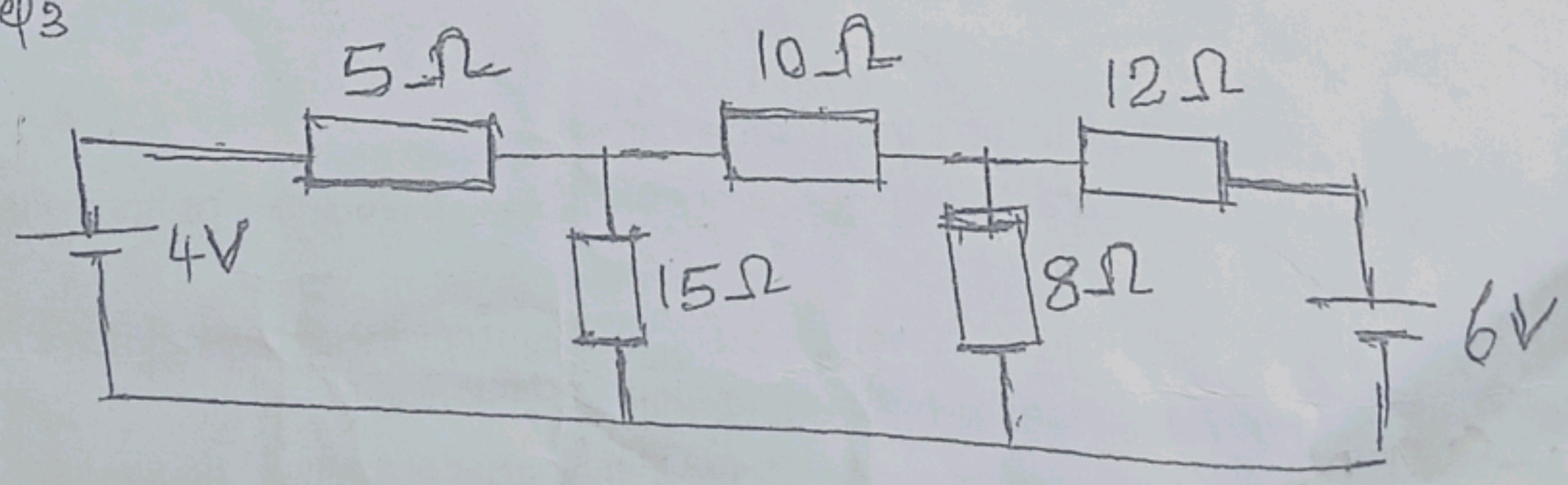
Q3. (a) State Superposition theorem and Kirchhoff's laws 4 marks

(b) For the network drawn below, calculate the value of currents in the 15 Ω and 8 Ω resistors by:

(i) superposition theorem 8 marks

(ii) Kirchhoff's laws. 8 marks

Fig. Q3



Q4 (a) Define the following quantities, in words and mathematically, with respect to capacitive circuits:

(i) Electric field strength $\frac{\text{force}}{\text{charge}}$ 2 marks

(ii) Electric flux density 2 marks

(iii) permittivity of free space. 2 marks

(b) Obtain the mathematical relationship for the quantities in (a) 4 marks

(c) A capacitor is made with two metal plates and separated by sheets of mica having a thickness of o.3 mm and a relative permittivity of 6. The area of one side of the plates is 500cm^2. Calculate the capacitance. (Take $\varepsilon_o = 8.85 \times 10^{-12}$ F/m)

4 marks

(d) If a p.d of 400 V is maintained across the terminals of the capacitor in (c), calculate:

(i) the charge 2 marks

(ii) the electric field strength 2 marks

(iii) the electric flux density in the dielectric. 2 mark

Q5. (a) With respect to LRC series resonant circuits, define:

(i) Q – factor (ii) circuit band-width 2 marks

(b) A circuit, having a resistance of 4 Ω and inductive reactance of 20 Ω and capacitive reactance of 20 Ω in series, is connected across 20 V supply.

(i) Draw the circuit

2 marks

(ii) Calculate the current at resonance 2 marks

(iii) What are the voltages across each of the three series components, L,R and C?

6 marks

(iv) Calculate Q-factor if the resonant frequency is 6 kHz. 2 marks

(v) Determine the half-power frequencies and the bandwidth 4 marks

(vi) What is the power dissipated in the circuit at the two frequencies? 2 marks