UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
JULY 2023 SEMESTER

COURSE CODE	:	SRD 11403
COURSE NAME	:	ELECTRICAL TECHNOLOGY
PROGRAMME NAME	:	DIPLOMA
DATE	:	27 SEPTEMBER 2023
TIME	:	9.00 AM – 11.00 AM
DURATION	:	2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given on the question paper. This question paper has information printed on both sides of the paper.

2. This question paper consists of TWO (2) sections: Section A and Section B.

3. Answer ALL questions from Section A in the OMR answer sheet provided.

4. Answer THREE (3) questions ONLY from Section B in the answer booklet provided.

5. Answer all questions in English language ONLY.

6. Formula sheet is appended.

THERE ARE 10 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.

1. Determine which portion of an atom has no electrical charge.
    A. electron
    B. proton
    C. neutron
    D. neutral

2. All the effects of electric current take place because of the movement of _____.
    A. free electron
    B. free proton
    C. free neutron
    D. nucleus

3. An atom having more electrons than protons is said to be _____.
    A. positively charged
    B. negatively charged
    C. neutrally charged
    D. discharged

4. Select the appropriate prefix for 150×10^{-3} H.
    A. 0.15H
    B. 150kH
    C. 150mH
    D. 150µH

5. Which of the following metric prefixes could replace 10^{-12}?
    A. micro
    B. mega
    C. kilo
    D. pico

6. Add 21 mA and 8000 µA and express the result in milliamperes.
    A. 290 mA
    B. 29 mA
    C. 218 mA
    D. 21.8 mA

7. The rate at which work is performed is called _____.
    A. current
    B. energy
    C. power
    D. voltage

8. *"The internal friction which retards the flow of current (electrons) through a material"*.

    The statement can best be described for _____.
    A. power
    B. voltage
    C. resistance
    D. current

9. Ohm's law is a relationship between _____.
    A. voltage, current and time
    B. current, power and resistance
    C. resistance, time and current
    D. voltage, current and resistance

10. In a series circuit, which of the parameters remain constant across all circuit elements such as resistor, capacitor, and inductor?
    A. Voltage
    B. Current
    C. Both above
    D. None of the above

11. Convert the following capacitance value, 22nF to μF.
    A. 0.022μF
    B. 0.00055μF
    C. 0.22μF
    D. 200nF

12. A 10 V battery is connected across four 100Ω resistors in series. What is the value of the current that flows through each resistor?
    A. 2.5 mA
    B. 25 mA
    C. 250 mA
    D. 0.25 mA

13. Five equal values of resistors are connected in series with a 20V source. A current of 4mA is measured in the circuit. What could be the value for each resistor connected in the circuit?
    A. 1kΩ
    B. 5kΩ
    C. 125Ω
    D. 20Ω

14. Which of the following electrical magnitude is the common reference for a parallel circuit?
    A. resistance
    B. current
    C. voltage
    D. power

15. As additional resistors are connected to a parallel circuit, predict what will happen to the total resistance in the circuit.
    A. increase
    B. increase by the value of the resistor being connected
    C. decrease
    D. remain unchanged

16. A 50Ω resistor is connected in parallel with another 15Ω resistor. What will be the value of total resistance in the circuit?
    A. 17.1Ω
    B. 11.5Ω
    C. 16.5Ω
    D. 74Ω

17. The total current entering a junction may be different from the total current leaving the junction. Relate your understanding to the Kirchoff Current Law (KCL).
    A. True
    B. False

18. The rate of changing direction is called the frequency of the AC. It is measured in hertz (Hz), which refers to the number of forwards-backwards cycles per second.
    A. True
    B. False

19. Which of the following is not the magnitude of a sinusoidal wave in an AC system?
    A. Peak value
    B. Root mean square value
    C. Resistive value
    D. None of the above

20. The opposition to alternating current by a capacitor in known as capacitive reactance.
    A. True
    B. False

21. In a series RC network, the capacitive reactance tends to increase as frequency increases.
    A. True
    B. False

22. As the supply frequency increases in a series RL network, the inductive reactance also increases.
    A. True
    B. False

23. *"The effective resistance of an electric circuit or component to alternating current, arising from the combined effects of ohmic resistance and reactance."*
    The above statement is best described by _____.
    A. Resistance
    B. Inductance
    C. Impedance
    D. Reactance

24. In a series RLC network, the reactance of both capacitor and inductor tends to cancel each other.
    A. True
    B. False

25. If the capacitive reactance (X_C) is less than the inductive reactance (X_L) in a series RLC network, the circuit is predominantly inductive. Which of the following best described the effect on voltage and current in the circuit?
    A. current leads voltage by $\theta°$
    B. current lags voltage by $\theta°$
    C. both voltage and current are in the same phase angle
    D. none of the above

SECTION B (Total: 75 marks)

INSTRUCTION: Answer THREE (3) questions ONLY.

Question 1

Refer to the circuit shown in Figure 1.

(a)   Calculate R_T, I_1 and V_1.

(7 marks)

(b)   Use any method that you know to solve for I_2, I_3, I_4, V_2, V_3 and V_4.

(12 marks)

(c)   Calculate the power dissipated at resistor R_4.

(2 marks)

(d)   Relate the value of current I_3 and I_4 with the value of resistance R_3 and R_4 shown in the circuit.

(2 marks)

(e)   Relate the value of V_2, V_3 and V_4 to the type of connection for resistors R_2, R_3 and R_4 shown in the circuit.
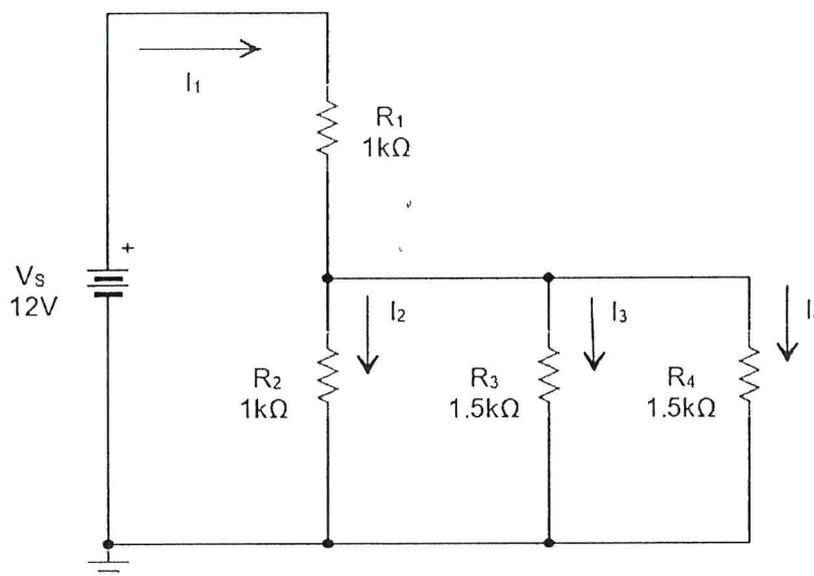
(2 marks)

Figure 1: Resistive Network

Question 2

There are two meshes in the circuitry as shown in Figure 2.

(a) Solving two meshes using Mesh Current Analysis method to solve for I_1 and I_2. Then calculate the value of voltages across R_1, R_2 and R_3.

(18 marks)

(b) The flow of electric current traverses resistor R_3, which is the result of the combination of currents I_1 and I_2. In order to obtain the voltage across resistor R_3, it is necessary to establish a connection between Ohm's Law and the currents I_1 and I_2. Redraw the circuit diagram and show the values of the currents flowing through each component and the voltages across resistors R_1, R_2, and R_3.
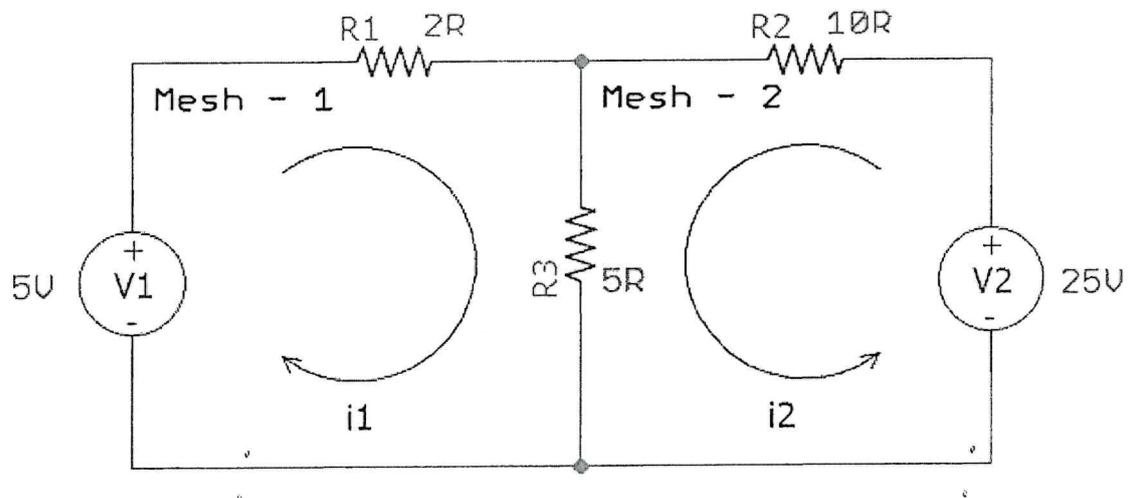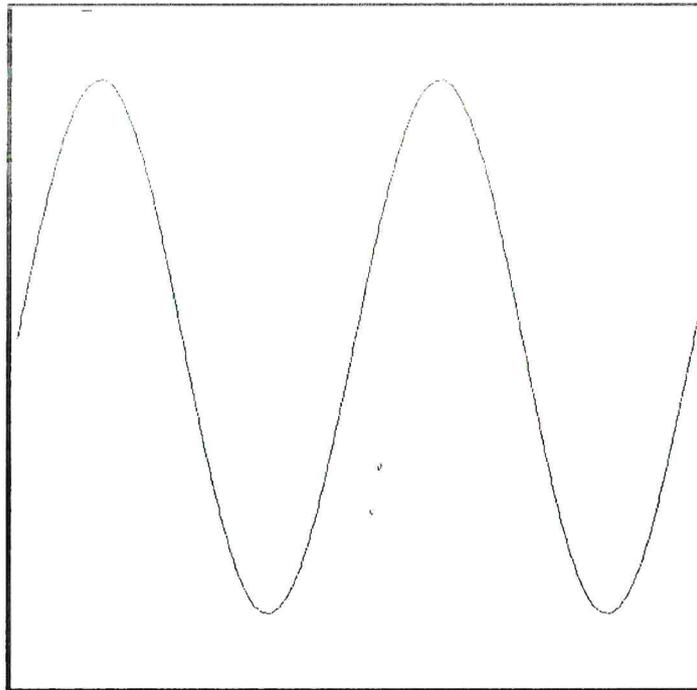
(7 marks)

Figure 2: Resistive Network

Question 3

(a)   A sinusoidal waveform on the oscilloscope screen is displayed in Figure 3. Show the calculation steps for the following magnitudes and the appropriate unit for each magnitude.

   i.   period

   ii. frequency

   iii. peak value

   iv. peak-to-peak value

   v.   root-mean square (effective) value

   vi. average value

   vii. Describe the difference between root-mean square value and average value obtained from part (v) and part (vi) above by relating your answer to the appropriate formula.

Horizontal Setting: 500µs/div
Vertical Setting: 2V/div

Figure 3: Sinusoidal Waveform

(16 marks)

(b)   Consider the circuit shown in Figure 4. By using any appropriate method prove that the voltage V_b across resistor R_3 has a value of 24 volts.
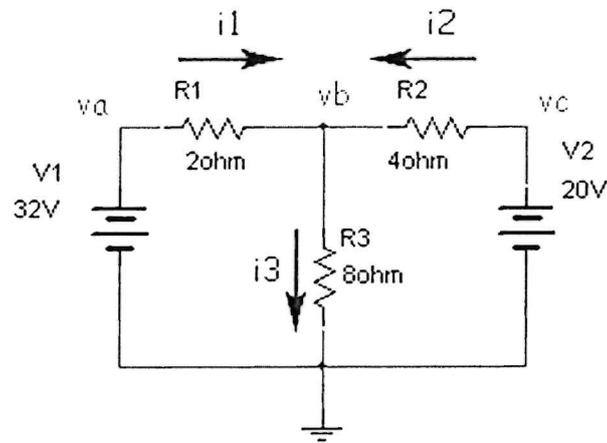

Figure 4: Resistive Circuit Network

(9 marks)

Question 4

Figure 5 shows a series RLC circuit containing a resistance of 12Ω, an inductance of 0.15H and a capacitor of 100uF are connected in series across a 100V, 50Hz supply. Calculate the following magnitudes:

(a)   Total impedance

(b)   Current in the circuit

(c)   Total voltage across the resistor

(d)   Total voltage across the inductor

(e)   Total voltage across the capacitor

(f)   True Power

(g)   Apparent power

(h)   Power factor
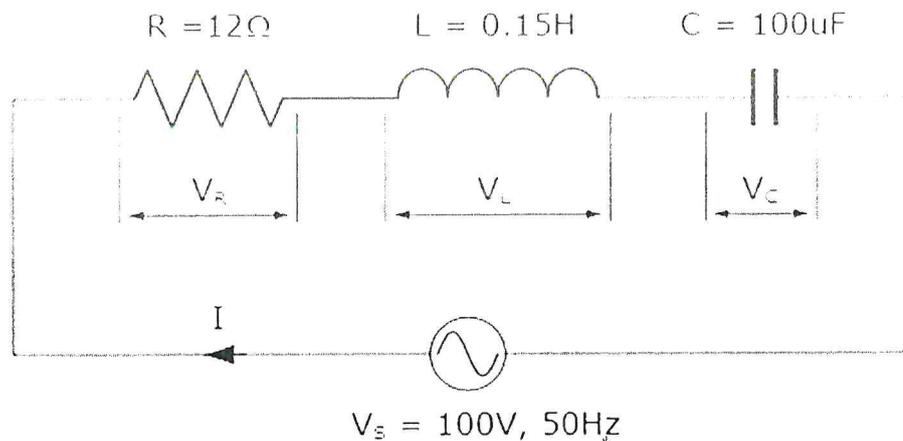
(i)   Sketch the voltage phasor diagram

Figure 5: RLC Network

(25 marks)

END OF QUESTION PAPER

FORMULA SHEET

$$V = \frac{W}{Q}$$

$$I = \frac{Q}{t}$$

$$W = F \times d$$

$$P = \frac{W}{t}$$

$$V = I \times R$$

$$P = I^2 \times R$$

$$P = V \times I$$

$$P = \frac{V^2}{R}$$

$$R_T = R_1 + R_2 + R_3 + \cdots R_n$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots \frac{1}{R_n}$$

$$V_x = \frac{R_x}{R_T} \times V_T$$

$$I_x = \frac{R_T}{R_x} \times I_T$$

$$\sum V = V_s - V_1 - V_2 - V_3 - \cdots V_n$$

$$\sum I = I_s - I_1 - I_2 - I_3 - \cdots I_n$$

$$P_T = P_1 + P_2 + P_3 + \cdots P_n$$

$$V_{pp} = 2 \times V_p$$

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

$$f = \frac{1}{T}$$

$$V_{ave} = \frac{2 \times V_p}{\pi}$$

$$C = \frac{Q}{V}$$

$$Q = C \times V$$

$$C_T = C_1 + C_2 + C_3 + \cdots C_n$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots \frac{1}{C_n}$$

$$X_C = \frac{1}{2\pi f C}$$

$$\theta = tan^{-1}\left(\frac{-X_C}{R}\right)$$

$$Z = \sqrt{R^2 + X_C^2}$$

$$V_T = \sqrt{V_R^2 + V_C^2}$$

$$V = I \times Z$$

$$V_C = I \times X_C$$

FORMULA SHEET

$$L_T = L_1 + L_2 + L_3 + \cdots L_n$$

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \cdots \frac{1}{L_n}$$

$$X_L = 2\pi f L$$

$$\theta = tan^{-1}\left(\frac{-X_L}{R}\right)$$

$$Z = \sqrt{R^2 + X_L{}^2}$$

$$V_T = \sqrt{V_R{}^2 + V_L{}^2}$$

$$V_L = I \times X_L$$

$$X_{tot} = |X_L - X_C|$$

$$Z_{tot} = \sqrt{R^2 + X_{tot}{}^2}$$

$$\theta = tan^{-1}\left(\frac{X_{tot}}{R}\right)$$

$$P_{true} = V \times I \cos\theta$$

$$P_{reactive} = V \times I \sin\theta$$

$$P_{apparent} = V \times I$$