Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ELECTRIC AND ELECTRONICS TECHNOLOGY
COURSE CODE	:	BDA 14303
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	

1. PART A: ANSWER **ONE (1)** QUESTION FROM TWO (2) QUESTIONS ONLY.
   PART B: ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA
   ☐ Open book
   ☒ Closed book
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

PART A: ANSWER ONE QUESTION ONLY

Q1 Mesh and nodal analysis are two methods used in electrical engineering to analyse circuits.

(a) As shown in **Figure APPENDIX A.1** use mesh analysis to find V_o.

(10 marks)

(b) Explain the purpose of nodal analysis in electrical circuits.

(2 marks)

(c) Using nodal analysis, determine the voltage across the resistor R_2 as shown in **Figure APPENDIX B.1.**

(8 marks)

Q2 Please answer the following questions.

(a) As shown in **Figure APPENDIX C.1** calculate the current *Ix* and *Iy* in the following circuit using mesh analysis.

(10 marks)

(b) Based on **Figure APPENDIX D.1**, find Vo using nodal analysis.

(10 marks)

PART B: ANSWER ALL QUESTIONS

Q3 Please answer the following questions

(a) Calculate the current flowing through 20Ω as shown in **Figure APPENDIX E.1** using the superposition principle.

(10 marks)

(b) Based on Figure **APPENDIX F.1**:

(i) Determine the equivalent circuit to the left of the terminals a-b in the circuit using Thevenin's theorem.

(8 marks)

(ii) Identify the current through R_1.

(2 marks)

Q4 Capacitors and inductors are electronic components that can store energy.

(a) Identify the capacitance of the single capacitor which is equal to the equivalent to the capacitance of the circuit in Figure **APPENDIX G.1.**

(5 marks)

(b) Find V_c, i_L and the energy stored in the capacitor and inductor in the circuit of **Figure APPENDIX H.1** under DC condition.

(7 marks)

(c) The switch in **Figure APPENDIX I.1** has been closed for a long time, and it is opened at t=0. Determine $V(t)$ for $t \geq 0$.

(8 marks)

Q5 Refer to **Figure APPENDIX J.1,** a 50 Ω resistor (R), a 0.1 H inductor (L) and a 50 μF capacitor (C) are connected in series to a 50 Hz source (V). The RMS current, I_{RMS} in the circuit is 2A.

(a) Determine the total circuit impedance.

(7 marks)

(b) Identify the rms voltage across the resistor, inductor, capacitor and the RLC combination.

(5 marks)

(c) Calculate the power factor.

(2 marks)

(d) Sketch the phasor diagram for this circuit.

(4 marks)

(e) Explain the relationship between the total current and the voltage supply.

(2 marks)

Q6 Please answer the following questions.

(a) State two (2) differences between AC motor and DC motor.

(4 marks)

(b) An ideal transformer is rated at 2400/120V, 9.6kVa and has 50 turns on the secondary side. Calculate:

(i) The turn ratio.

(2 marks)

(ii) The number of turn on the primary side.

(2 marks)

(iii) The current rating for primary and secondary winding.

(2 marks)

(c) Construct the truth table describing the output of the circuit described by the logic diagram in **Figure APPENDIX K.1** and write the Boolean expression.

(10 marks)

- END OF QUESTIONS -

APPENDIX A

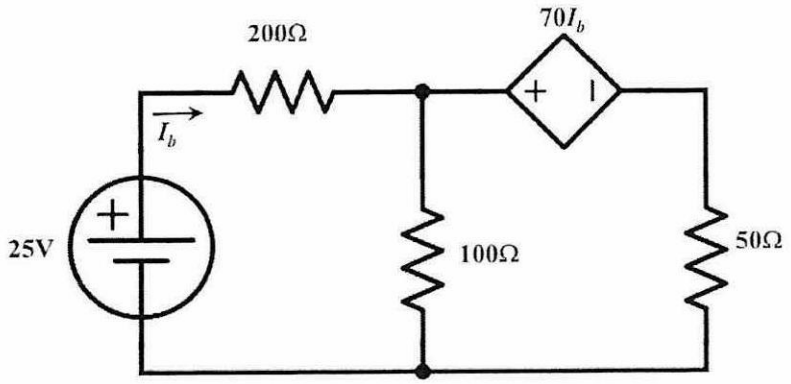


Figure APPENDIX A.1

APPENDIX B

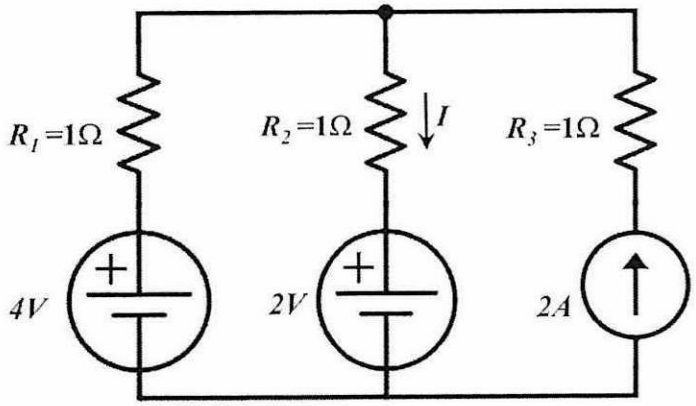


Figure APPENDIX B.1

APPENDIX C

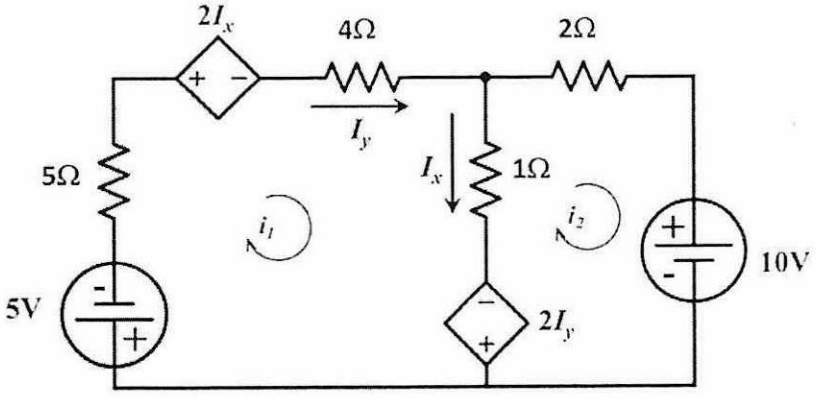


Figure APPENDIX C.1

APPENDIX D

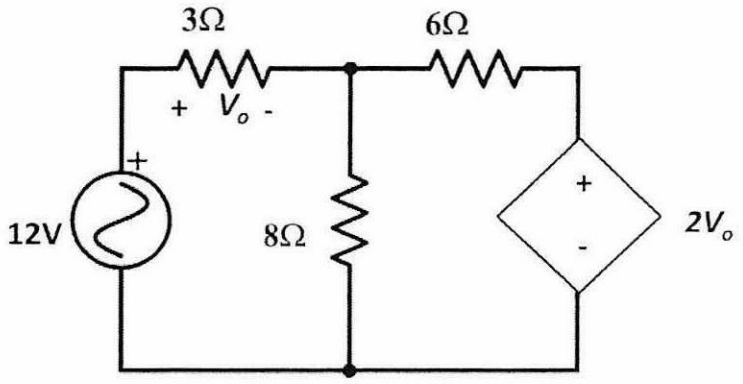


Figure APPENDIX D.1

APPENDIX E

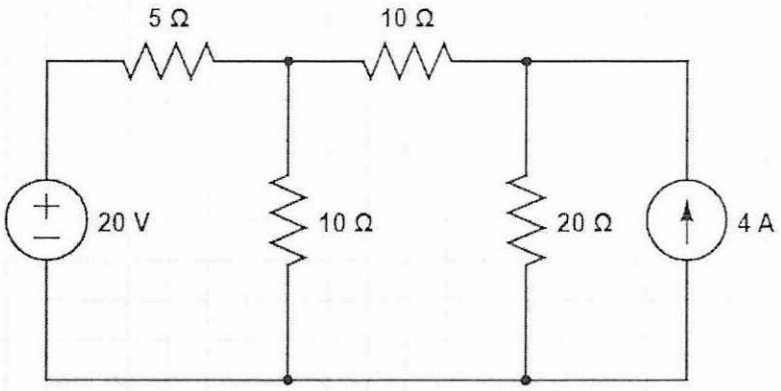


Figure APPENDIX E.1

APPENDIX F

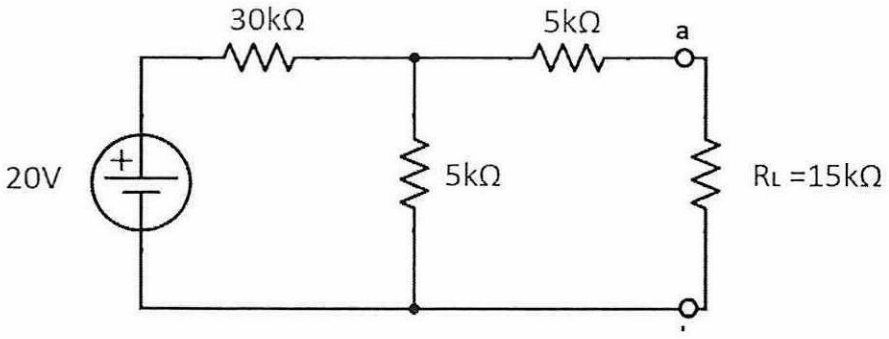


Figure APPENDIX F.1

APPENDIX G

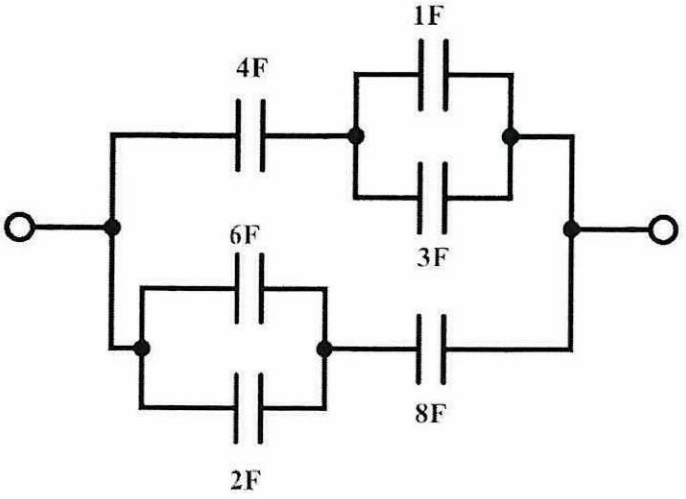


Figure APPENDIX G.1

APPENDIX H

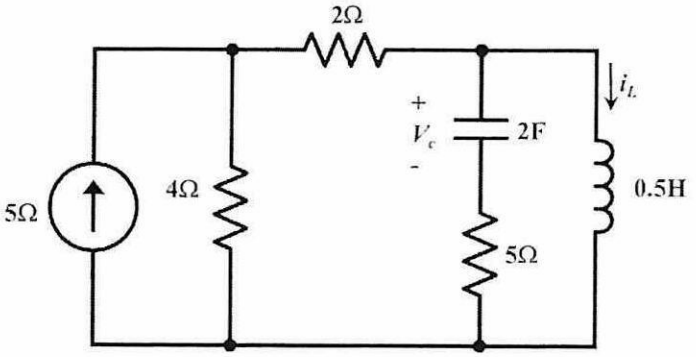


Figure APPENDIX H.1

APPENDIX I

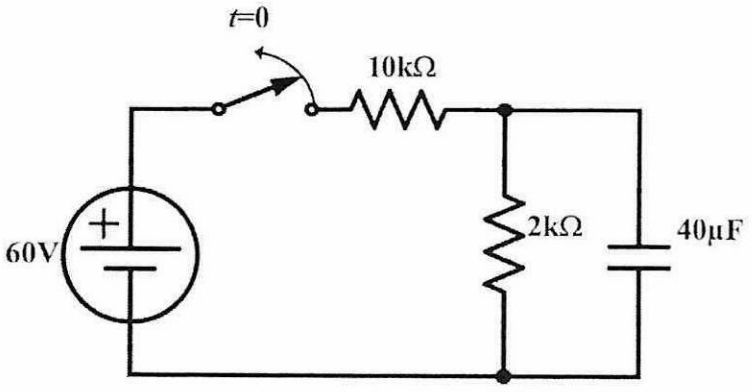


Figure APPENDIX I.1

APPENDIX J

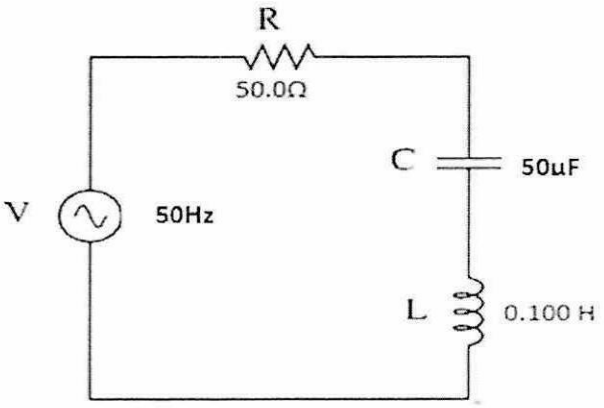


Figure APPENDIX J.1

APPENDIX K

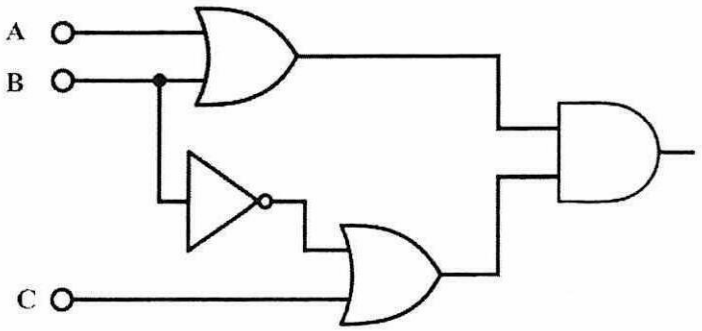


Figure APPENDIX K.1

APPENDIX L

LIST OF FORMULA

OHMS LAW

$$V = IR$$

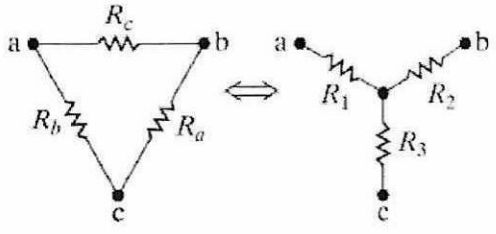
JOULE'S LAW

$$P = IV$$

KIRCHHOFF LAW

$$\sum_{k=1}^{n} i_k = 0 \qquad \sum_{v=1}^{n} v_k = 0$$

WYE-DELTA TRANSFORMATION

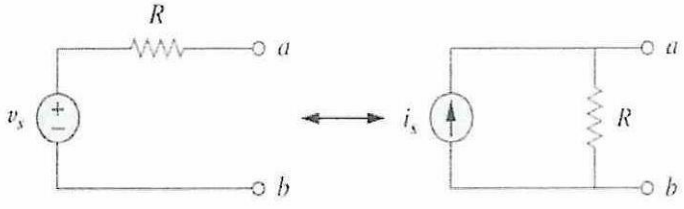


$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} \qquad R_1 = \frac{R_bR_c}{R_a + R_b + R_c}$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2} \qquad R_2 = \frac{R_cR_a}{R_a + R_b + R_c}$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3} \qquad R_1 = \frac{R_aR_b}{R_a + R_b + R_c}$$

SOURCE TRANSFORMATION



$$V_S = I_sR$$

THEVENIN AND NORTON EQUIVALENT CIRCUIT

$$R_{TH} = R_N \qquad I_N = \frac{V_{TH}}{R_{TH}}$$

$$P = i^2R_L = \left(\frac{V_{TH}}{R_{TH} + R_L}\right)^2 R_L \qquad \text{When } R_L \neq R_{TH}$$

$$P_{\max} = \frac{V_{TH}^{\ 2}}{4R_{TH}} \qquad \text{When } R_L = R_{TH}$$

CAPACITOR AND INDUCTOR

$$C = \frac{\varepsilon A}{d} \qquad v(t) = \frac{1}{C}\int_{-\infty}^{t} i(t)dt + v(t_0)$$

$$i = C\frac{dv}{dt} \qquad w = \frac{1}{2}Cv^2$$

$$L = \frac{N^2 \mu A}{l} \qquad v = L\frac{di}{dt}$$

$$i = \frac{1}{L}\int_{t_0}^{t} v(t)dt + i(t_0) \qquad w = \frac{1}{2}Li^2$$

$$\tau = RC \qquad \tau = \frac{L}{R}$$

ALTERNATING CURRENT POWER CALCULATION

$$P(t) = v(t)i(t)$$ Instantaneous power

$$P = \frac{1}{2}\mathrm{Re}[VI^*] = \frac{1}{2}V_m I_m \cos(\theta_v - \theta_i)$$ Average power

$$i_{RMS} = \sqrt{\frac{1}{T}\int_0^T i^2 dt}$$

$$P_{RMS} = {I_{RMS}}^2 R = \frac{{V_{RMS}}^2}{R}$$

TRANSFORMERS

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$