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Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2017/2018

| | | |
|---|---|---|
| COURSE NAME | : | ELECTRICAL AND ELECTRONIC TECHNOLOGY |
| COURSE CODE | : | BDU 10803 |
| PROGRAMME CODE | : | BDC / BDM |
| EXAMINATION DATE | : | DECEMBER 2017 / JANUARY 2018 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | 1. PART A (COMPULSORY): ANSWER **ALL** QUESTIONS<br>2. PART B (OPTIONAL): ANSWER **THREE (3)** QUESTIONS ONLY |

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THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

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## PART A

**Q1** (a) With simple sketches, define the sinusoidal and cosine waveform for AC voltage and AC current.

(4 marks)

(b) Calculate the RMS value and the average value of the voltage wave shown in **Figure Q1(b).**

(6 marks)

(c) As shown in **Figure Q1(c)**, a 50.0Ω resistor (R), a 0.100H inductor (L) and a 10.0μF capacitor (C) are connected in series to a 60.0Hz source (V). The rms current, $I_{rms}$ in the circuit is 2.75A.

(i) Calculate the rms voltage across the resistor, inductor and capacitor

(4 marks)

(ii) Calculate the rms voltage across the RLC combination

(2 marks)

(iii) Sketch the phasor diagram for this circuit

(4 marks)

**Q2** (a) Reduce the function specified in the truth table of **Table Q2(a)** to its minimum sum-of-product (SOP) form using a Karnaugh map. Subsequently, draw the logic circuit using NAND gates only.

**Table Q2(a)**

| **INPUTS A B C** | **OUTPUT X** |
|---|---|
| 0 0 0 | 1 |
| 0 0 1 | 1 |
| 0 1 0 | 0 |
| 0 1 1 | 1 |
| 1 0 0 | 1 |
| 1 0 1 | 1 |
| 1 1 0 | 0 |
| 1 1 1 | 1 |

(10 marks)

(b) In digital system, different gates are connected to perform different functions. Such circuits are called combinational logic circuit. **Figure Q2(b)** shows a combinational logic circuit.

(i) Obtain the complete Boolean expression for Z

(4 marks)

(ii) Using Boolean expression for Z in **Q2(b)(i),** build a truth table for the circuit and evaluate Z for each input combination.

(6 marks)

**PART B**

**Q3** (a) Explain the definition of current, I and voltage, V in electricity,

(4 marks)

(b) Refer to the circuit shown in **Figure Q3(b),** determine the power for the voltage source, dependent source, element 1, element 2 and element 3 and indicate whether the power is either absorbed or supplied.

(8 marks)

(c) Suppose your car battery runs down. Instead of the required 13V across it, you are getting 10V, so you ask for a jump from a friend. The correct procedure is to connect the positive terminals of the batteries (the negative terminals are already connected to the car chassis), and connect the chassis(s) to each other. As you do so, right before you connect the chassis, the situation is similar to as shown in **Figure Q3(c).**

(i) Sketch the circuit for **Figure Q3(c)** and label the nodes.

(4 marks)

(ii) Find the voltage, Vg across the gap.

(4 marks)

**Q4** (a) Explain the meaning Kirchhoff's voltage law.

(4 marks)

(b) Determine the resistance value of the resistors shown in **Figure Q4(b)**. Find the minimum and maximum value for the resistor.

(4 marks)

(c) Determine the current, i that flows in the resistor 17Ω as shown in **Figure Q4(c)** using a Wye-Delta conversion.

(12 marks)

**Q5** (a) Explain the steps required in order to perform nodal analysis in electric circuits.

(4 marks)

(b) As shown in **Figure Q5(b)**, a 120Ω resistor (R1), a 360Ω resistor (R2) and a 240Ω resistor (R3) are connected to a 28V voltage source (Vs1) and a 12V voltage source (Vs2). Using nodal analysis, determine the current flows in R2 and the power consumption of R3.

(6 marks)

(c) As shown in **Figure Q5(c)**, a 6Ω resistor (R1), a 2Ω resistor (R2), a 6Ω resistor (R3), a 4Ω resistor (R4), a 3Ω resistor (R5) are connected to a 12V voltage source (VS1), an 1A current source (IS1) and 3A current source (IS2). Determine the current value ($I_{R1}$) that flows across resistor, R1 and the voltage drop ($V_{R4}$) across resistor, R4 by applying mesh technique. Use the proposed loop mesh current, I1, I2, I3 and I4 as shown in the **Figure Q5(c).**

(10 marks)

**Q6** (a) Explain the steps to implement Thevenin theorems in electric circuit analysis.

(4 marks)

(b) As shown in **Figure Q6(b),** a 3Ω resistor (R1), a 6Ω resistor (R2) and a 5Ω resistor (R3) are connected to a 10V voltage source (VS1). Calculate the value of Vth and the Rth of the circuit.

(10 marks)

(c) (i) Determine the suitable resistive load that can deliver maximum power transfer of Port A and B as determined in **Q6(b)**.

(2 marks)

(ii) Calculate the maximum power transfer of the circuit.

(4 marks)

**Q7** (a) With simple sketches, explain how circuits with energy storage elements behave differently than circuits without energy storage elements.

(4 marks)

(b) (i) Simplify the circuit in **Figure Q7(b)** to a single inductor and a single capacitor.

(2 marks)

(ii) Determine the equivalent capacitance and inductance.

(4 marks)

(c) The switch in the circuit in **Figure Q7(c)** has been closed for a long time. It is opened at $t = 0$. Calculate the capacitor voltage $v(t)$ for $t > 0$.

(10 marks)



**-END OF QUESTIONS –**

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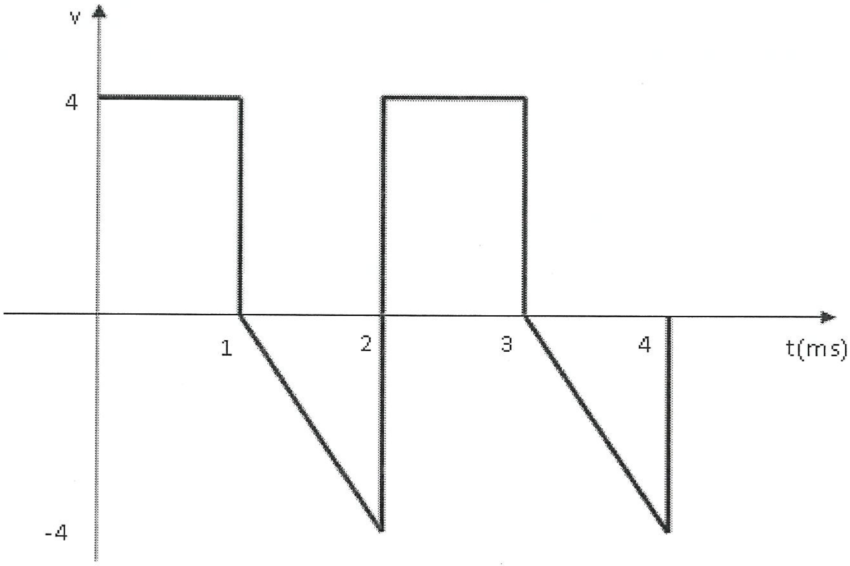


**Figure Q1(b)**

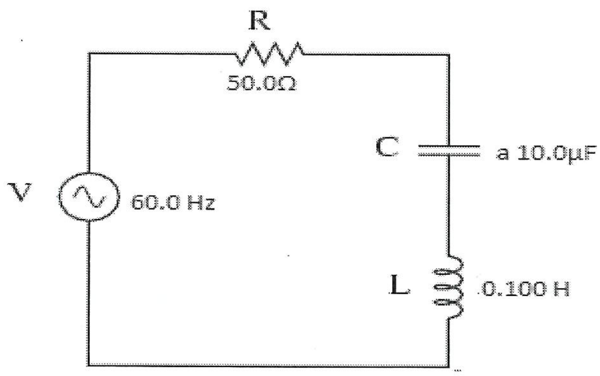


**Figure Q1(c)**

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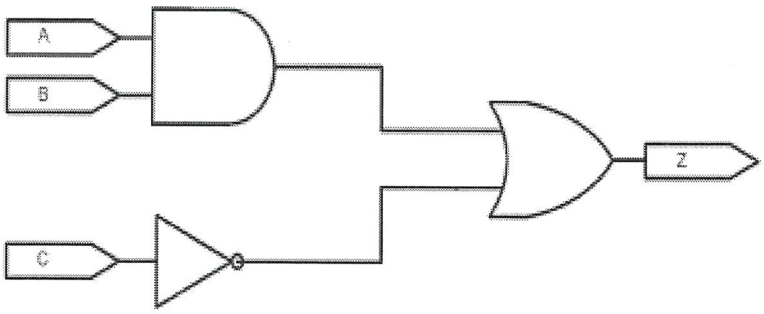


**Figure Q2(b)**

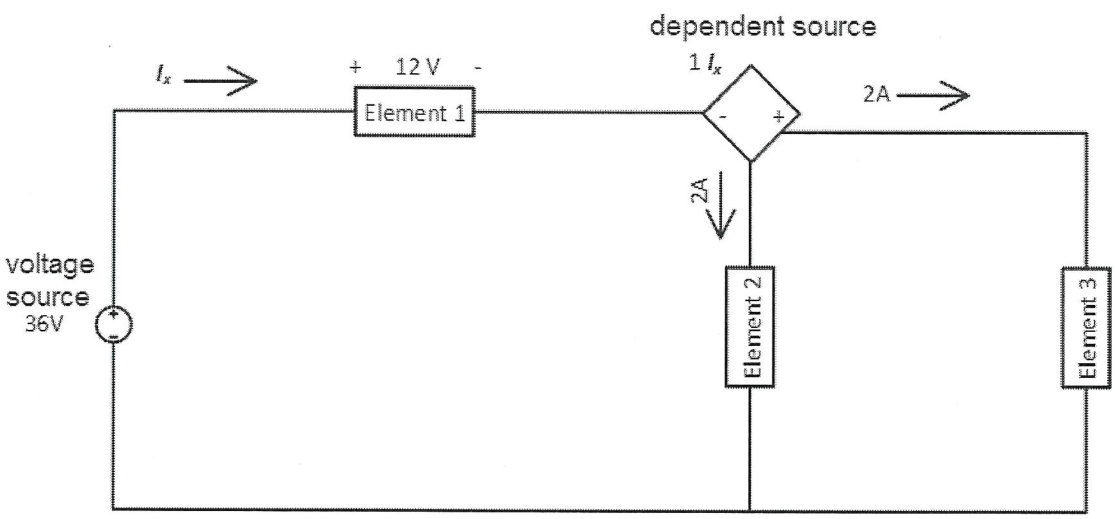


**Figure Q3(b)**

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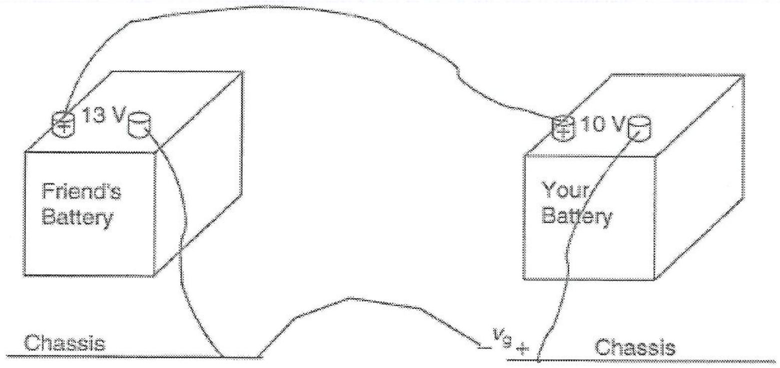


**Figure Q3(c)**

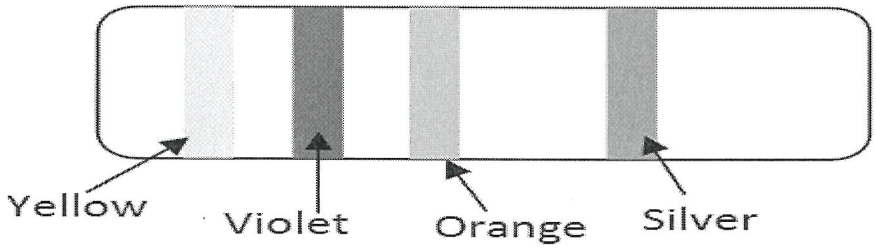


**Figure Q4(b)**

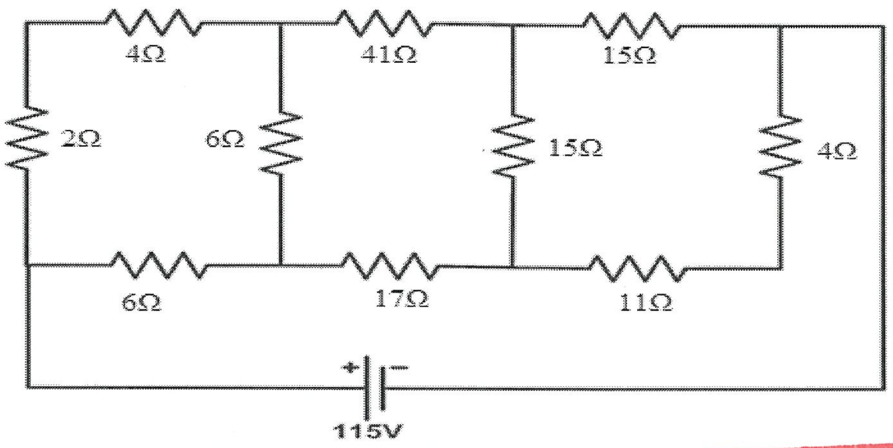


**Figure Q4(c)**

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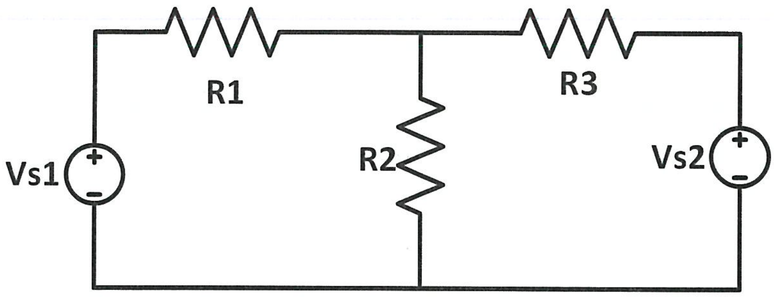


**Figure Q5(b)**

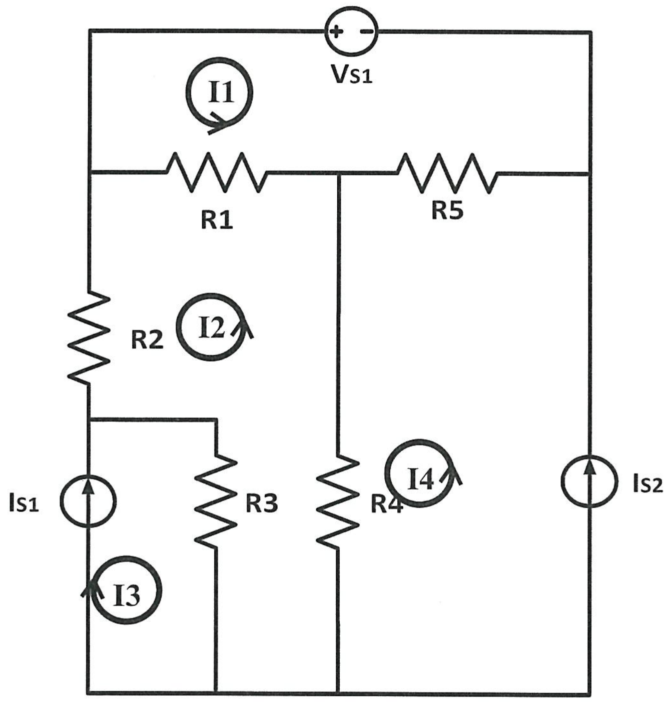


**Figure Q5(c)**

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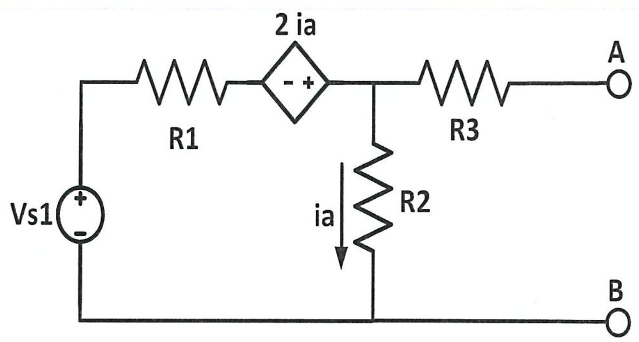


**Figure Q6(b)**

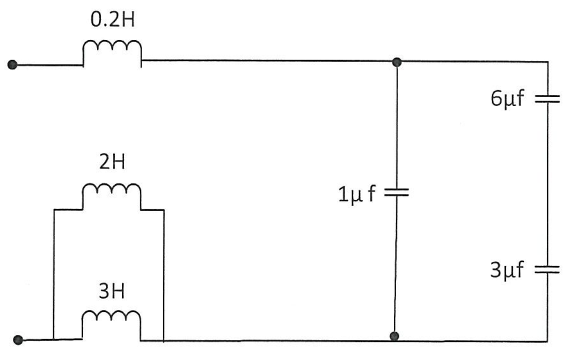


**Figure Q7(b)**

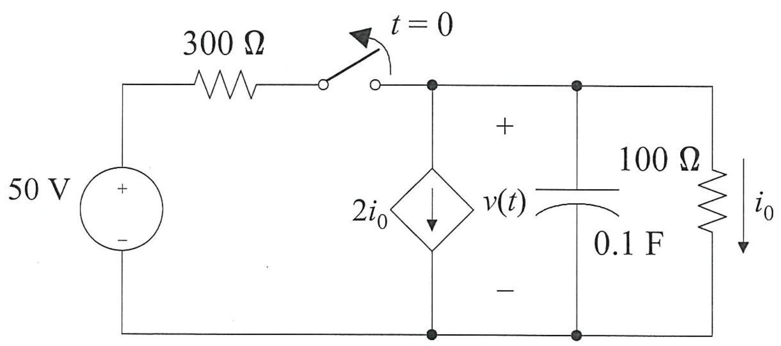




**Figure Q7(c)**

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## LIST OF FORMULA

**OHMS LAW**

$$V = IR$$

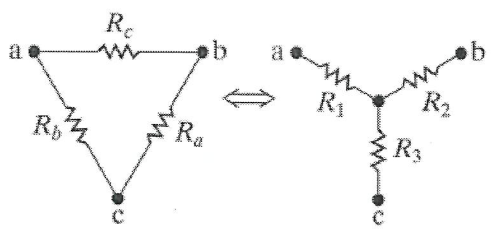
**JOULE'S LAW**

$$P = IV$$

**KIRCHHOFF LAW**

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

**WYE-DELTA TRANSFORMATION**




$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

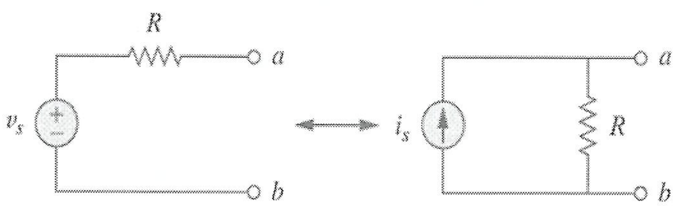
$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

$$R_1 = \frac{R_bR_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_cR_a}{R_a + R_b + R_c}$$

$$R_1 = \frac{R_aR_b}{R_a + R_b + R_c}$$

**SOURCE TRANSFORMATION**




$$V_S = I_sR$$

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**THEVENIN AND NORTON EQUIVALENT CIRCUIT**

$$R_{TH} = R_N$$

$$IN = \frac{V_{TH}}{R_{TH}}$$

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

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

**CAPACITOR AND INDUCTOR**

$$C = \frac{\varepsilon A}{d}$$

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

$$i = C\frac{dv}{dt}$$

$$w = \frac{1}{2}Cv^2$$

$$L = \frac{N^2 \mu A}{l}$$

$$v = L\frac{di}{dt}$$

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

$$w = \frac{1}{2}Li^2$$

$$\tau = RC$$

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

**PHASOR REALTIONSHIP**

$$v(t+T) = v(t)$$

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

$$z = x + jy = r\angle\phi = r(\cos\phi + j\sin\phi)$$

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## ALTERNATING CURRENT POWER CALCULATION

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

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

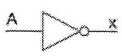
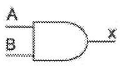
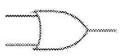
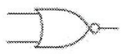
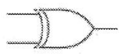
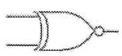
$$i_{RMS} = \sqrt{\frac{1}{T}\int_0^T i^2 dt}$$

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

## TRANSFORMERS

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

## LOGIC GATES

| Name | NOT | AND | NAND | OR | NOR | XOR | XNOR |
|---|---|---|---|---|---|---|---|
| Alg. Expr. | $\overline{A}$ | $AB$ | $\overline{AB}$ | $A+B$ | $\overline{A+B}$ | $A\oplus B$ | $\overline{A\oplus B}$ |
| Symbol |  |  |  |  |  |  |  |
| Truth Table | A X<br>0 1<br>1 0 | B A X<br>0 0 0<br>0 1 0<br>1 0 0<br>1 1 1 | B A X<br>0 0 1<br>0 1 1<br>1 0 1<br>1 1 0 | B A X<br>0 0 0<br>0 1 1<br>1 0 1<br>1 1 1 | B A X<br>0 0 1<br>0 1 0<br>1 0 0<br>1 1 0 | B A X<br>0 0 0<br>0 1 1<br>1 0 1<br>1 1 0 | B A X<br>0 0 1<br>0 1 0<br>1 0 0<br>1 1 1 |

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