



First Semester Examination
2022/2023 Academic Session

February 2023

EEE 105 – CIRCUIT THEORY I
(TEORI LITAR I)

Duration: 3 hours
(Masa: 3 jam)

Please ensure that this examination paper consists of TEN pages of printed material including appendix before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEPULUH muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]

Instructions: This question paper consists of **THREE (3)** questions. Answer **ALL** questions. All questions carry the same marks.

[Arahan: Kertas soalan ini mengandungi **TIGA (3)** soalan. Jawab **SEMUA** soalan. Semua soalan membawa jumlah markah yang sama.]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunakan.]

1. (a) Based on Figure 1(a), answer the following questions:

Berdasarkan Rajah 1(a), jawab soalan-soalan berikut:

- i) Prove that the equation for current division of i_2 is given by:
Buktikan bahawa persamaan untuk pembahagian arus i_2 diberikan oleh:

$$\frac{i_2}{G_2} = \frac{i}{G_1 + G_2 + G_3}$$

G_1 , G_2 and G_3 are conductance for resistors, R_1 , R_2 and R_3 respectively.
 G_1 , G_2 dan G_3 masing-masing adalah kekonduksian untuk R_1 , R_2 dan R_3 .

(13 marks/markah)

- ii) If given that $R_1 : R_2 : R_3 = 1 : 2 : 2$, find the ratio of $P_{R_1} : P_{R_2} : P_{R_3}$ where P_{R_1} , P_{R_2} and P_{R_3} are the power absorbed by R_1 , R_2 and R_3 respectively.

Diberikan bahawa $R_1 : R_2 : R_3 = 1 : 2 : 2$, dapatkan nisbah $P_{R_1} : P_{R_2} : P_{R_3}$ di mana P_{R_1} , P_{R_2} dan P_{R_3} masing-masing adalah kuasa yang diserap oleh R_1 , R_2 dan R_3 .

(17 marks/markah)

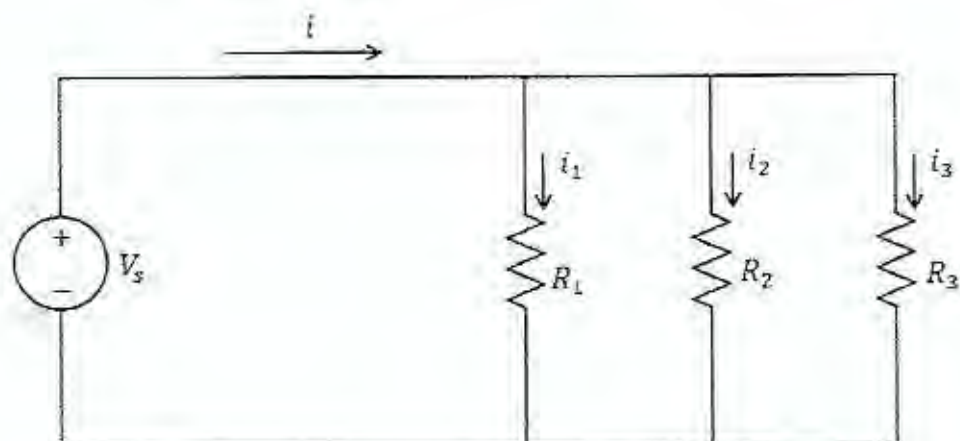


Figure 1(a)

Rajah 1(a)

(b) Based on Figure 1(b), answer the following questions

Berdasarkan Rajah 1(b), jawab soalan-soalan berikut:

i) Determine number of nodes, branches and loops.

Dapatkan bilangan nod, cabang dan gelung.

(6 marks/markah)

ii) By using **nodal analysis**, determine all node voltages. Then, calculate the power generated by voltage source, 12 V.

Dengan menggunakan **analisa nod**, dapatkan semua voltan nod. Kemudian, kira kuasa yang dijana oleh sumber voltan, 12 V.

(24 marks/markah)

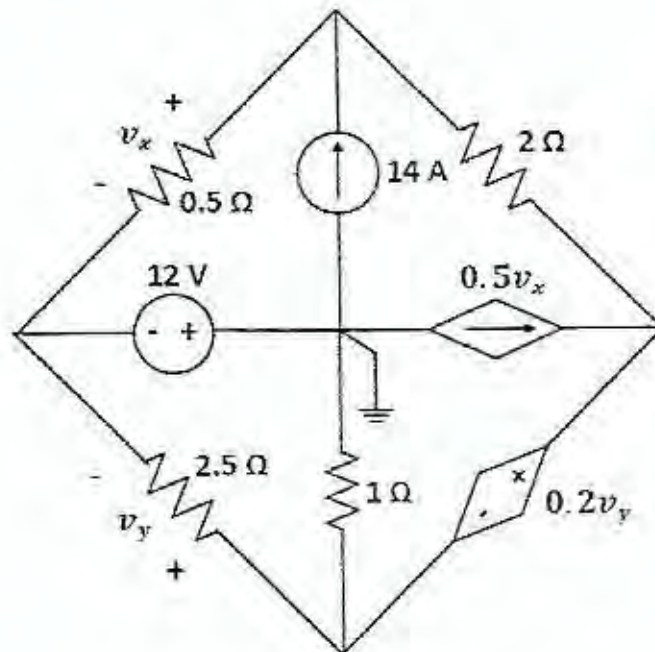


Figure 1(b)

Rajah 1(b)

- (c) By using **Ohm's and Kirchoff's Laws**, find the Thevenin equivalent voltage, V_{TH} and Thevenin equivalent resistance, R_{TH} at terminal a-b for the circuit shown in Figure 1(c). Then, determine the maximum power absorbed by resistor R_L .

Dengan menggunakan **Hukum Ohm dan Kirchoff**, dapatkan voltan kesetaraan Thevenin, V_{TH} dan rintangan kesetaraan Thevenin, R_{TH} pada terminal a-b untuk litar yang ditunjukkan pada Rajah 1(c). Kemudian, dapatkan kuasa maksimum yang diserap oleh perintang R_L .

(40 marks/markah)

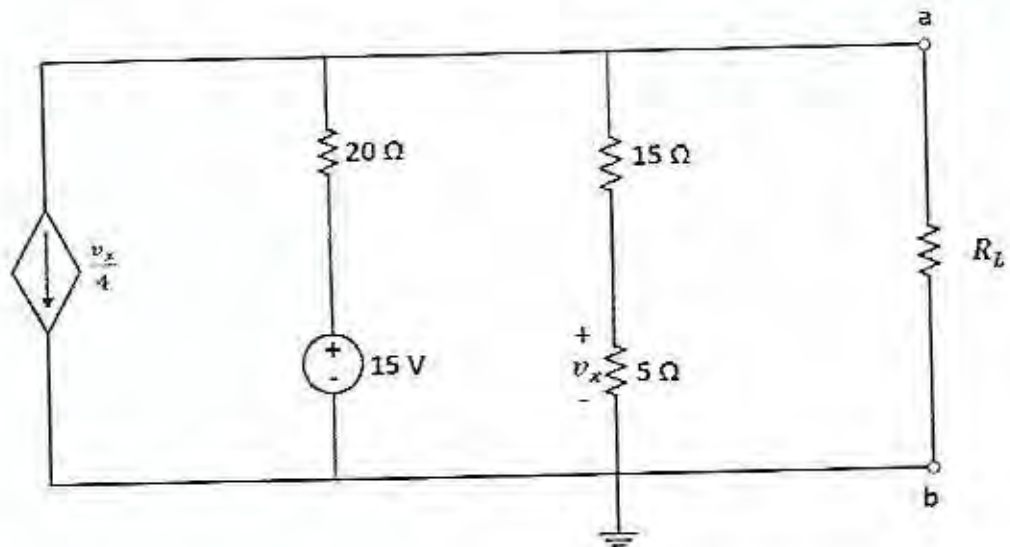


Figure 1(c)

Rajah 1(c)

2. (a) Based on Figure 2(a), calculate the energy stored in each capacitor under the DC condition.

Berdasarkan Rajah 2(a), kirakan tenaga yang disimpan dalam setiap kapasitor dalam keadaan DC.

(25 marks/markah)

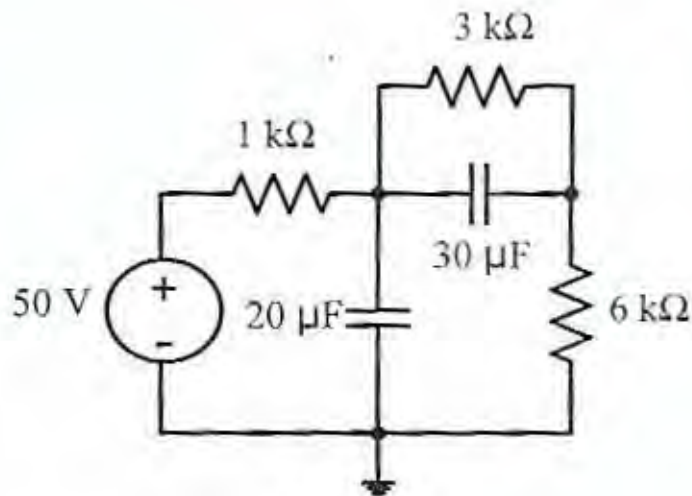


Figure 2(a)
Rajah 2(a)

- (b) Based on Figure 2(b), determine the input impedance, Z_{in} at $\omega = 20$ rad/s.

Berdasarkan Rajah 2(b), tentukan nilai galangan masukan, Z_{in} at $\omega = 20$ rad/s.

(20 marks/markah)

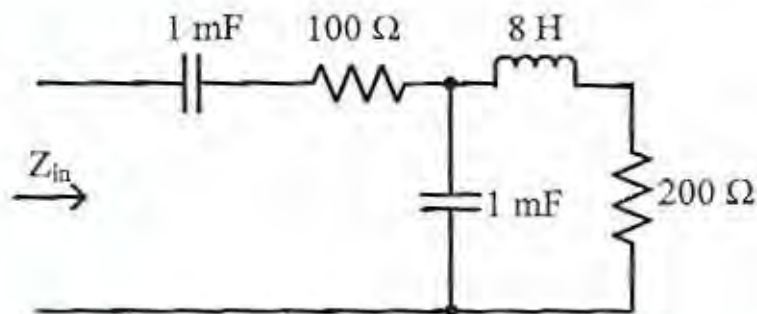


Figure 2(b)
Rajah 2(b)

- (c) Analyse the circuit in Figure 2(c) and determine $v(t)$ and $i(t)$.

Analisa litar dalam Rajah 2(c) dan tentukan $v(t)$ dan $i(t)$.

(30 marks/markah)

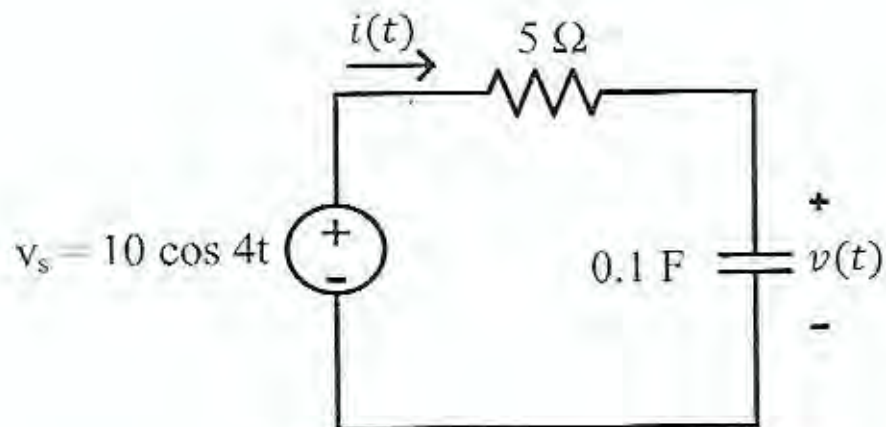


Figure 2(c)

Rajah 2(c)

- (d) Analyse the circuit in Figure 2(d) in frequency domain and determine $v_o(t)$.

Analisa litar dalam Rajah 2(d) dalam domain frekuensi dan tentukan $v_o(t)$.

(25 marks/markah)

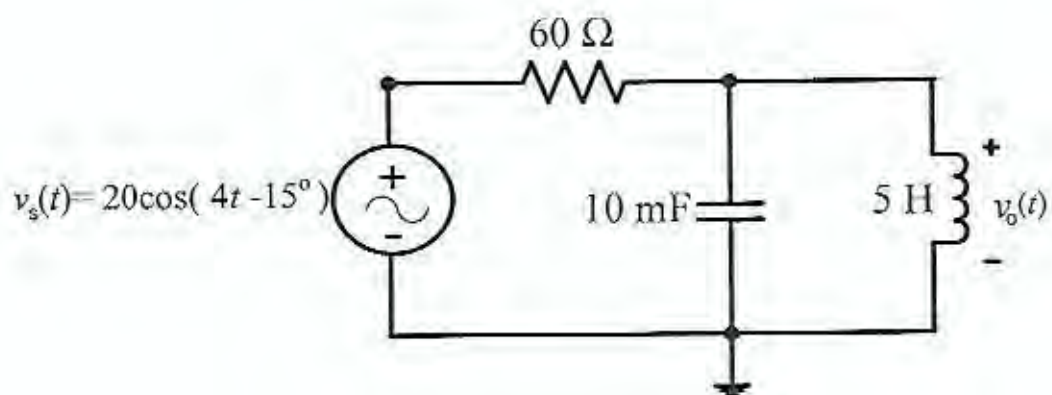


Figure 2(d)

Rajah 2(d)

3. (a) Based on Figure 3(a), answer the following questions:
 Berdasarkan Rajah 3(a), jawab soalan-soalan berikut:

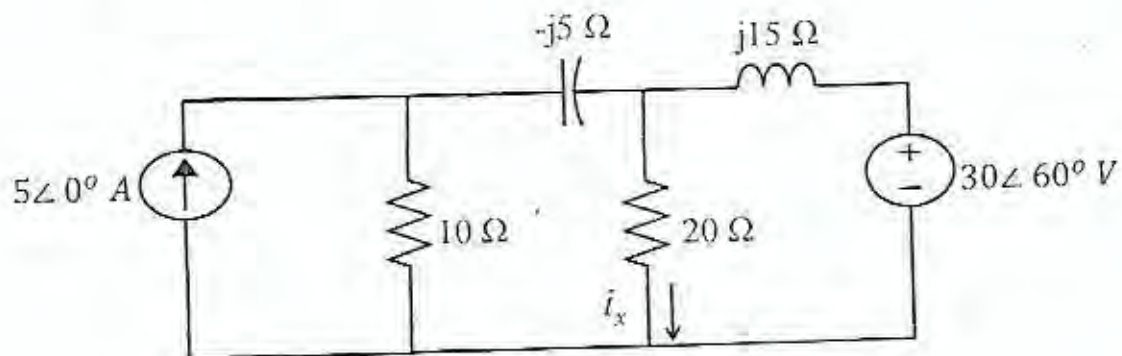


Figure 3(a)

Rajah 3(a)

- i) By using **source transformation**, determine the current i_x .
 Dengan menggunakan **transformasi sumber**, dapatkan arus i_x .
 (20 marks/markah)
- ii) Verify your answer in 3(a)(i) using **Thevenin Theorem**.
 Sahkan jawapan anda dalam 3(a)(i) menggunakan **Teorem Thevenin**.
 (20 marks/markah)

(b) Based on the circuit in Figure 3(b), calculate:

Berdasarkan litar dalam Rajah 3(b), kira:

- i) The complex power S_1 and S_2 supplied by the voltage source V_1 and V_2 .

Kuasa kompleks S_1 dan S_2 yang dibekalkan oleh sumber voltan V_1 dan V_2 .

(18 marks/markah)

- ii) The complex power absorbed by each of the circuit elements (inductor, resistor and capacitor).

Kuasa kompleks yang diserap oleh setiap elemen litar (peraruh, perintang dan pemuat).

(12 marks/markah)

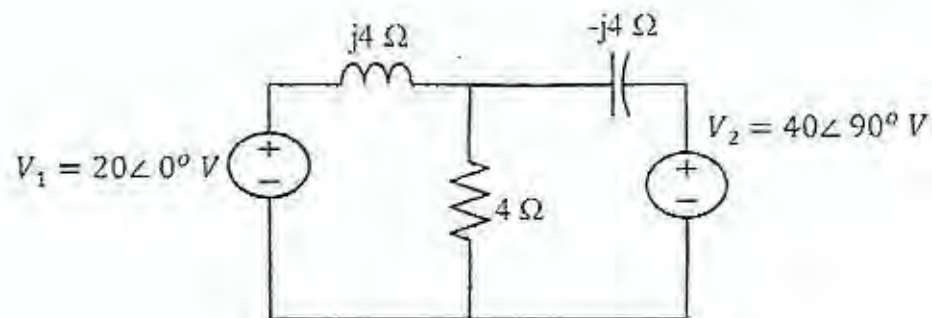


Figure 3(b)

Rajah 3(b)

- (c) Consider the Y- Δ connected three-phase circuit in Figure 3(c). It has the line impedance, $Z_{line} = j5 \Omega$ and Δ -connected load with $Z_{\Delta} = 15 - j15 \Omega$.
 Pertimbangkan litar tiga fasa yang disambungkan secara Y- Δ dalam Rajah 3(c). Ia mempunyai galangan talian, $Z_{line} = j5 \Omega$ dan beban yang disambung secara Δ dengan $Z_{\Delta} = 15 - j15 \Omega$.

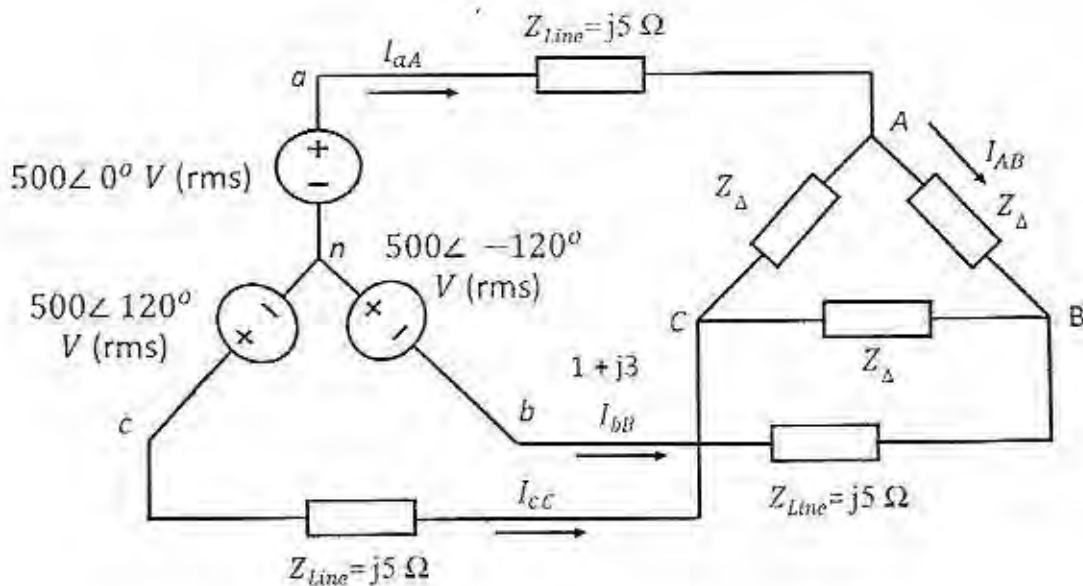


Figure 3(c)
 Rajah 3(c)

- i) Construct a single-phase equivalent circuit of the system.
 Bina litar setara fasa tunggal bagi system ini.
 (7 marks/markah)
- ii) Calculate the phase and line currents.
 Kira arus fasa dan talian.
 (16 marks/markah)
- iii) Calculate the total complex power of the Δ -connected three-phase load.
 Kira jumlah kuasa kompleks beban tiga fasa bersambung- Δ
 (7 marks/markah)

APPENDIX A

LAMPIRAN A

Course Outcomes (CO) – Programme Outcomes (PO) Mapping
Pemetaan Hasil Pembelajaran Kursus – Hasil Program

Questions <i>Soalan</i>		CO	PO
1	a	2	2
	b	2	2
	c	2	2
2	a	3	2
	b	3	2
	c	3	2
	d	3	2
3	a	4	2
	b	4	2
	c	4	2