

**SULIT**



**KEMENTERIAN PENDIDIKAN TINGGI  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI**

**BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI  
KEMENTERIAN PENDIDIKAN TINGGI**

**JABATAN KEJURUTERAAN ELEKTRIK**

**PEPERIKSAAN AKHIR**

**SESI I : 2023/2024**

**DET20033: ELECTRICAL CIRCUITS**

**TARIKH : 7 JUN 2024**

**MASA : 8.30 AM – 10.30 AM (2 JAM)**

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Kertas ini mengandungi (7) halaman bercetak.  
Bahagian A: Struktur (4 soalan)  
Bahagian B: Esei (1 soalan)  
Dokumen sokongan yang disertakan : Formula

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**SECTION A: 80 MARKS**  
**BAHAGIAN A: 80 MARKAH**

**INSTRUCTION:**

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab SEMUA soalan.*

**QUESTION 1**

**SOALAN 1**

- CLO1 (a) Identify **TWO (2)** methods to generate alternating current (AC).
- Kenal pasti DUA (2) kaedah untuk menjana arus ulang-alik.*
- [4 marks]  
[4 markah]
- CLO1 (b) Discuss **THREE (3)** factors that affect the amount of voltage induced in alternating current (AC).
- Bincangkan TIGA (3) faktor yang mempengaruhi jumlah voltan teraruh dalam arus ulang-alik.*
- [6 marks]  
[6 markah]
- CLO1 (c) An alternating circuit (AC) has a voltage value,  $v = 240 \sin(300\pi t + 0.5)$  V at instantaneous time,  $t$  seconds. Calculate:
- Sebuah litar arus ulang alik mempunyai nilai voltan,  $v = 240 \sin(300\pi t + 0.5)V$  pada masa ketika,  $t$  saat. Kira:*
- i. The amplitude  
*Nilai amplitud*
  - ii. Root mean square voltage ( $V_{rms}$ ) and average voltage ( $V_{avg}$ )  
*Voltan punca ganda dua ( $V_{rms}$ ) dan Voltan purata ( $V_{purata}$ ).*

iii. The frequency

*Nilai frekuensi*

iv. The value of voltage when  $t = 2.0$  ms

*Nilai voltan ketika  $t = 2.0$  ms*

[10 marks]

[10 markah]

## QUESTION 2

### SOALAN 2

CLO1

(a) Given  $v = 15 \sin(\omega t + 45^\circ)$  V and  $i = 5 \sin(\omega t + 20^\circ)$  A. Determine phase relationships and sketch the waveforms.

*Diberi  $v = 15 \sin(\omega t + 45^\circ)$  V dan  $i = 5 \sin(\omega t + 20^\circ)$  A. Tentukan hubungan fasa dan lakarkan bentuk gelombang.*

[5 marks]

[5 markah]

CLO1

(b) Based on Figure A2(b), simplify the inductive circuit to obtain the total inductance.

*Berdasarkan Rajah A2(b), permudahkan litar aruhan tersebut untuk mendapatkan jumlah kearuhan.*

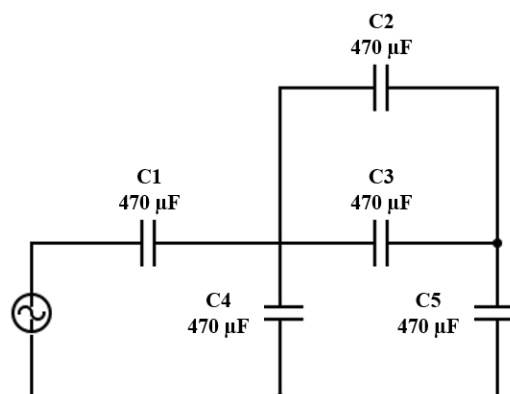


Figure A2(b) / Rajah A2(b)

[5 marks]

[5 markah]

- CLO1 (c) A series resonance circuit consisting of a resistor of  $100\ \Omega$ , a capacitor of  $47\ \mu\text{F}$  and an inductor of  $70\ \text{mH}$  connected a sinusoidal supply voltage which has a constant output of  $5\ \text{V}$  at all frequency. Calculate:
- resonance frequency
  - current resonance
  - voltage across the inductor and capacitor at resonance.
  - quality factor,  $Q$

*Litar salun siri dengan rintangan  $100\ \Omega$ , pemuat  $47\ \mu\text{F}$  dan pearuh  $70\ \text{mH}$  disambungkan kepada bekalan voltan sinusoidal yang mempunyai keluaran malar  $5\ \text{V}$  pada semua frekuensi. Kira:*

- frekuensi salun*
- arus salun*
- voltan merentasi peraruh dan pemuat semasa salun.*
- faktor kualiti,  $Q$*

[10 marks]

[10 markah]

**QUESTION 3****SOALAN 3**

- CLO1 (a) List **FOUR (4)** types of transformer.  
*Senarai **EMPAT (4)** jenis pengubah.*

[4 marks]

[4 markah]

- CLO1 (b) Identify **SIX (6)** characteristics of an ideal transformer.  
*Kenal pasti **ENAM (6)** ciri-ciri pengubah unggul.*

[6 marks]

[6 markah]

- CLO1 (c) Referring to the Figure A3(c) below, calculate primary voltage ( $V_P$ ), secondary voltage ( $V_S$ ), primary current ( $I_P$ ) and secondary current ( $I_S$ ).

*Dengan merujuk kepada Rajah A3(c), kira voltan primer ( $V_P$ ), voltan sekunder ( $V_S$ ), arus primer ( $I_P$ ) dan arus sekunder ( $I_S$ ).*

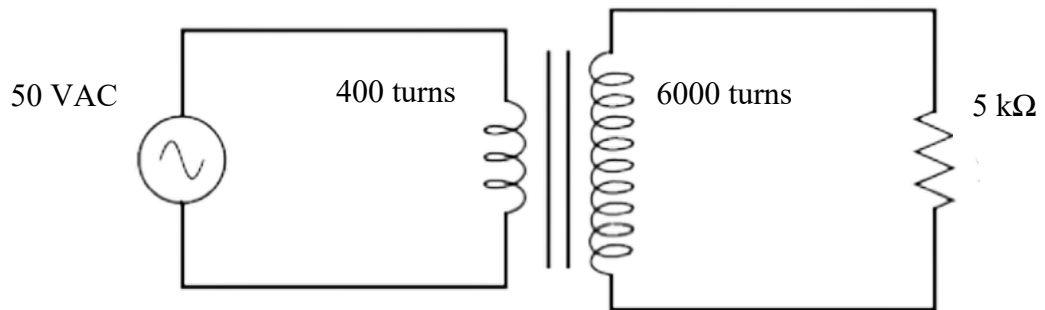


Figure A3(c) / Rajah A3(c)

[10 marks]

[10 markah]

#### QUESTION 4

#### SOALAN 4

- CLO1 (a) Explain the effects of changing the frequency to:
- RLC series circuit
  - RLC parallel circuit

*Terangkan kesan-kesan penukaran frekuensi kepada:*

- Litar sesiri RLC*
- Litar selari RLC*

[5 marks]

[5 markah]

- (b) One type of connection in a three phase system is a STAR connection. Explain the STAR connection in a three-phase system using a circuit diagram.

*Salah satu jenis sambungan dalam system tiga fasa ialah sambungan STAR. Terangkan sambungan STAR di dalam sistem tiga fasa dengan gambarajah litar yang berkenaan.*

[5 marks]

[5 markah]

CLO1

- (c) Three similar coils, each having a resistance of  $5 \Omega$  and inductive reactance of  $4.5 \Omega$  are connected in star to a 415 V, three-phase supply. Calculate :
- (i) line and phase voltages
  - (ii) phase and line currents
  - (iii) total power dissipated

*Tiga gegelung yang serupa, setiap satu mempunyai rintangan  $3.0 \Omega$  dan tindak balas induktif  $4.5 \Omega$  disambungkan dalam bentuk bintang kepada bekalan 3 fasa 415 V. Kirakan :*

- (i) voltan talian dan voltan fasa*
- (ii) arus fasa dan arus talian*
- (iii) jumlah pelepasan kuasa*

[10 marks]

[10 markah]

**SECTION B: 20 MARKS*****BAHAGIAN B: 20 MARKAH*****INSTRUCTION:**

This section consists of **ONE (1)** essay question. Answer the question.

***ARAHAN:***

*Bahagian ini mengandungi SATU (1) soalan esei. Jawab soalan tersebut.*

**QUESTION 1*****SOALAN 1***

CLO1

An alternating voltage given by  $v = 300 \sin 400t$  volts is applied across a series combination of three impedances. The impedances comprise an inductance of 120 mH and 20  $\Omega$  resistance, an inductance of 350 mH and 70  $\Omega$  resistance, and a capacity of capacitance 270  $\mu\text{F}$  and 45  $\Omega$  resistance. Calculate the circuit impedance, circuit current, phase angle, power factor and true power. Then, draw a phasor diagram representing the circuit.

*Diberi voltan ulang-alik  $v = 300 \sin 400t$  disambung secara siri merentasi tiga galangan. Galangan tersebut terdiri daripada nilai pearuh, 120 mH dan nilai perintang, 20  $\Omega$ , nilai pearuh, 350 mH dan nilai perintang, 70  $\Omega$  dan nilai pemuat, 270  $\mu\text{F}$  dan nilai perintang, 45  $\Omega$ . Kira galangan litar, arus litar sudut fasa, faktor kuasa dan kuasa sebenar. Kemudian, lukis gambar rajah fasa yang mewakili litar.*

[20 marks]

[20 markah]

***SOALAN TAMAT***

LAMPIRAN

SENARAI FORMULA

$V_P = \sqrt{2} \times V_{rms}$	$X_L = 2\pi fL$	$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$
$I_P = \sqrt{2} \times I_{rms}$	$X_C = \frac{1}{2\pi fC}$	$Z_T = \frac{V_S}{I_T}$
$V_{PP} = 2V_P$	$Z_T = \sqrt{R^2 + X_{eq}^2}$ if $X_L > X_C$ ; $X_{eq} = X_L - X_C$ if $X_C > X_L$ ; $X_{eq} = X_C - X_L$	$\theta = \tan^{-1}\left(\frac{I_C - I_L}{I_R}\right)$
$I_{PP} = 2I_P$	$I_T = \frac{V_S}{Z_T}$	$i(t) = I_P \sin(\omega t \pm \theta)$
$V_{rms} = \frac{V_P}{\sqrt{2}}$	$\theta = \cos^{-1} PF$	$Q = IV \sin \theta$ $Q = I^2  X_C - X_L $
$I_{rms} = \frac{I_P}{\sqrt{2}}$	$\theta = \tan^{-1}\left(\frac{X_C - X_L}{R}\right)$ $\theta = \tan^{-1}\left(\frac{V_C - V_L}{V_S}\right)$	$S = IV$ $S = I^2 Z$
$V_{ave} = \frac{2V_P}{\pi}$	$\cos \theta = \frac{R}{Z}$	$P = IV \cos \theta$
$I_{ave} = \frac{2I_P}{\pi}$	$V_R = IR$	$Q = IV \sin \theta$
$T = \frac{1}{f}$ $T = \frac{2\pi}{\omega}$	$V_L = IX_L$ $V_C = IX_C$	$\theta = \cos^{-1} PF = \cos^{-1} 1 = 0^\circ$
$f = \frac{1}{T}$ $f = \frac{\omega}{2\pi}$	$\theta = \tan^{-1}\left(\frac{X_C - X_L}{R}\right) = \tan^{-1}\left(\frac{0}{R}\right) = 0^\circ$ $\theta = \tan^{-1}\left(\frac{V_C - V_L}{V_S}\right) = \tan^{-1}\left(\frac{0}{V_S}\right) = 0^\circ$	
$\omega = 2\pi f$ $\omega = \frac{2\pi}{T}$	$S = IV$ $S = I^2 Z$	$\cos \theta = \frac{R}{Z} = \frac{R}{R} = 1$
$v(t) = V_P \sin(\omega t \pm \theta)$	$P = IV \cos \theta$ $P = I^2 R$	$f_r = \frac{1}{2\pi\sqrt{LC}}$
$BW = f_H - f_L = \frac{f_r}{Q}$	$f_L = f_r - \frac{BW}{2}$ $f_L = f_r + \frac{BW}{2}$	$Q = \frac{X_L}{R} = \frac{X_C}{R} = \frac{V_L}{V_S} = \frac{V_C}{V_S} = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{f_r}{BW}$



LAMPIRAN

$$\eta = \frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$$

$$V_L = V_{RY} = V_{YB} = V_{BR}$$

$$V_L = \sqrt{3} V_P$$

$$V_L = V_{RY} = V_{YB} = V_{BR}$$

$$V_L = V_P$$

$$V_2 = \frac{N_2}{N_1} \times V_1$$

$$V_2 = \frac{P_2}{I_2}$$

$$Z_P = \sqrt{R^2 + X_{eq}^2}$$

$$\text{if } X_L > X_C; \quad X_{eq} = X_L - X_C$$

$$\text{if } X_C > X_L; \quad X_{eq} = X_C - X_L$$

$$Z_P = \frac{V_P}{I_P}$$

$$V_1 = \frac{N_1}{N_2} \times V_2$$

$$V_1 = \frac{P_1}{I_1}$$

$$I_2 = \frac{V_2}{R_L}$$

$$I_1 = \frac{N_2}{N_1} \times I_2$$

$$S_1 = S_2$$

$$I_1 V_1 = I_2 V_2$$

$$P_1 = I_1 V_1$$

$$P_2 = I_2 V_2 \quad \text{or} \quad P_2 = I_2^2 R_L$$

$$P_1 = P_2$$

$$I_P = \frac{V_P}{Z_P}$$

$$I_P = I_L$$

$$I_P = \frac{V_P}{Z_P}$$

$$I_P = \frac{I_L}{\sqrt{3}}$$

$$I_L = I_P$$

$$I_L = \sqrt{3} I_P$$

$$S = 3 I_P V_P$$

$$S = \sqrt{3} I_L V_L$$

$$P = 3 I_P V_P \cos \theta$$

$$P = \sqrt{3} I_L V_L \cos \theta$$