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)

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

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

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 (Vrms) and average voltage (V_{avg})
Voltan punca ganda dua (Vrms) dan Voltan purata (Vpurata).

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 (ωt + 45°) V and i = 5 sin (ωt + 20°) A. Determine phase relationships and sketch the waveforms.

Diberi v = 15 sin (ωt + 45°) V dan i = 5 sin (ωt + 20°) 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.

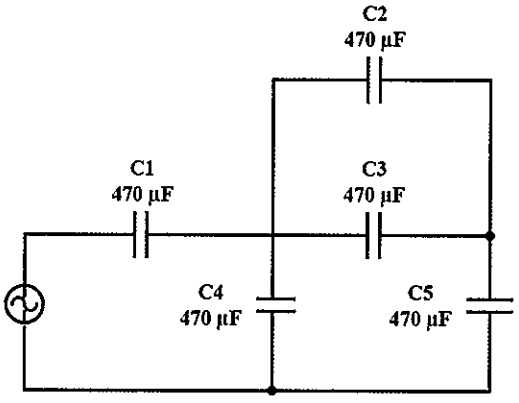

Figure A2(b) / *Rajah A2(b)*

[5 marks]
[5 *markah*]

CLO1 (c) A series resonance circuit consisting of a resistor of 100 Ω, a capacitor of 47 μF and an inductor of 70 mH connected a sinusoidal supply voltage which has a constant output of 5 V at all frequency. Calculate:

i. resonance frequency
ii. current resonance
iii. voltage across the inductor and capacitor at resonance.
iv. quality factor, Q

Litar salun siri dengan rintangan 100 Ω, pemuat 47 μF dan pearuh 70 mH disambungkan kepada bekalan voltan sinusoidal yang mempunyai keluaran malar 5 V pada semua frekuensi. Kira:

i. frekuensi salun
ii. arus salun
iii. voltan merentasi peraruh dan pemuat semasa salun.
iv. 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 voltage(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).

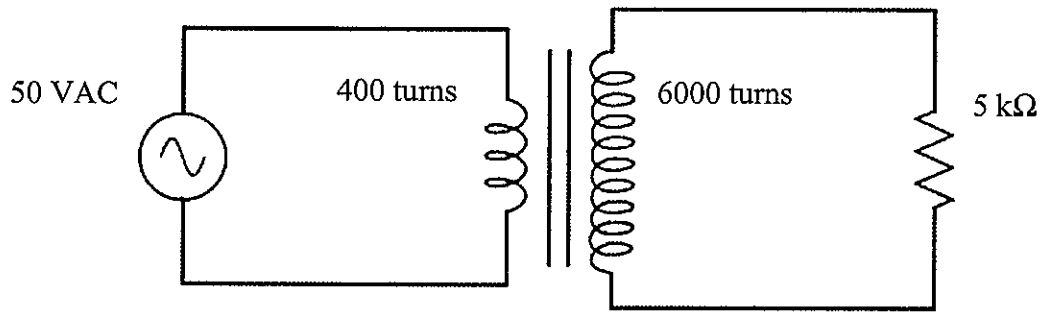

Figure A3(c) / *Rajah A3(c)*

[10 marks]
[10 *markah*]

QUESTION 4
SOALAN 4

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

Terangkan kesan-kesan penukaran frekuensi kepada:
i. Litar sesiri RLC
ii. 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 5.0 Ω and inductive reactance of 4.5 Ω 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 5.0 Ω dan tindak balas induktif 4.5 Ω 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 Ω resistance, an inductance of 350 mH and 70 Ω resistance, and a capacity of capacitance 270 μF and 45 Ω 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 Ω, nilai pearuh, 350 mH dan nilai perintang, 70 Ω dan nilai pemuat, 270 μF dan nilai perintang, 45 Ω. Kira galangan litar, arus litar sudut fasa, faktor kuasa dan kuasa sebenar. Kemudian, lukis gambar rajah fasa yang yang mewakili litar.

[20 marks]

[*20 markah*]

SOALAN TAMAT

LAMPIRAN

SENARAI FORMULA

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

$\eta = \frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$	$V_L = V_{RY} = V_{YB} = V_{BR}$ $V_L = \sqrt{3}\, V_P$	$V_L = V_{RY} = V_{YB} = V_{BR}$ $V_L = V_P$
$V_2 = \frac{N_2}{N_1} \times V_1$ $V_2 = \frac{P_2}{I_2}$	$Z_P = \sqrt{R^2 + X_{eq}^2}$ $if\ X_L > X_C;\ \ X_{eq} = X_L - X_C$ $if\ X_C > X_L;\ \ X_{eq} = X_C - X_L$ $Z_P = \frac{V_P}{I_P}$	
$V_1 = \frac{N_1}{N_2} \times V_2$ $V_1 = \frac{P_1}{I_1}$		
$I_2 = \frac{V_2}{R_L}$		
$I_1 = \frac{N_2}{N_1} \times I_2$		
$S_1 = S_2$ $I_1 V_1 = I_2 V_2$		
$P_1 = I_1 V_1$ $P_2 = I_2 V_2 \quad or \quad P_2 = I_2^2 R_L$ $P_1 = P_2$		
$I_P = \frac{V_P}{Z_P}$ $I_P = I_L$	$I_P = \frac{V_P}{Z_P}$ $I_P = \frac{I_L}{\sqrt{3}}$	
$I_L = I_P$	$I_L = \sqrt{3}\, I_P$	
$S = 3\, I_P V_P$ $S = \sqrt{3}\, I_L V_L$		
$P = 3\, I_P V_P \cos\theta$ $P = \sqrt{3}\, I_L V_L \cos\theta$		