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 II : 2024/2025

DET20123: ELECTRICAL CIRCUITS 2

TARIKH : 28 MEI 2025
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **ENAM (6)** 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) List **FOUR (4)** applications where alternating current (AC) is preferred over direct current (DC).
*Senaraikan **EMPAT (4)** aplikasi di mana arus ulang-alik (AU) lebih dipilih daripada arus terus (AT).*

[4 marks]
[4 *markah*]

CLO1 (b) Elaborate the process of generating alternating current using a simple AC generator. Include the role of Faraday's Law of Electromagnetic Induction and Lenz's Law in your explanation.
Terangkan proses penjanaan arus ulang-alik menggunakan penjana AU yang mudah. Sertakan peranan Hukum Faraday bagi Aruhan Elektromagnetik dan Hukum Lenz dalam penerangan anda.

[6 marks]
[*6 markah*]

CLO1 (c) Consider a sinusoidal voltage expressed by the equation, $v = 310 \sin (100\pi t + 30^{o})$ V at any time, t seconds. Calculate the peak voltage (V_p), Root Mean Square voltage (V_{rms}), Average voltage (V_{avg}), The instantaneous voltage at t = 5 ms and the time at which the voltage first reaches its maximum value.
Pertimbangkan voltan sinusoidal yang dinyatakan oleh persamaan, $v = 310 \sin (100\pi t + 30^{o})$ V pada bila-bila masa, t saat. Kira voltan puncak(Vp), Voltan

punca min kuasa dua (V_{pmkd}), Voltan purata (V_{purata}), Voltan seketika pada t = 5 ms dan Masa di mana voltan mula mencapai nilai maksimumnya.

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) With the aid of phasor diagrams and waveforms, compare the voltage and current relationship for a purely inductive circuit and a purely capacitive circuit.
Dengan bantuan gambarajah fasor dan bentuk gelombang, bandingkan hubungan voltan dan arus bagi litar aruhan tulen dan litar kemuatan tulen.

[5 marks]

[5 *markah*]

CLO1 (b) Interpret the actual power (P), reactive power (Q) and the apparent power (S) in AC circuits using the power triangle and relevant power formula.
Nyatakan kuasa aktif (P), kuasa reaktif (Q), dan kuasa ketara (S) dalam litar AU menggunakan segitiga kuasa dan formula kuasa yang berkaitan.

[5 marks]

[5 *markah*]

CLO1 (c) A coil of negligible resistance and inductance 2 mH is connected in series with a capacitance of 50 pF and a resistance of 36 Ω across 15V, variable frequency supply. Calculate the resonant frequency, the current at resonance, voltages across inductor at resonance, Q-factor, and bandwidth of the circuit.
Sebuah gegelung dengan rintangan yang boleh diabaikan dan pearuh 2 mH disambungkan secara siri dengan pemuat 50 pF dan rintangan 36 Ω merentasi bekalan frekuensi boleh ubah 15V. Kirakan frekuensi salun, arus ketika salun, voltan merentasi pearuh ketika salun, faktor Q, dan lebar jalur bagi litar tersebut.

[10 marks]

[10 *markah*]

QUESTION 3

SOALAN 3

CLO1 (a) List **FOUR (4)** types of transformers.

*Senaraikan **EMPAT (4)** jenis pengubah.*

[4 marks]

[4 *markah*]

CLO1 (b) Explain **SIX (6)** characteristics of an ideal transformer.

*Huraikan secara ringkas **ENAM (6)** ciri-ciri pengubah unggul.*

[6 marks]

[6 *markah*]

CLO1 (c) A 5:1 stepdown transformer has a full load secondary current of 20 A. A short circuit test for copper loss at full load gives a wattmeter reading of 100 W. If R_P is 0.3 Ω, calculate R_S.

Sebuah transformer injak turun 5:1 mempunyai arus sekunder beban penuh 20 A. Ujian litar pintas untuk kehilangan kuprum pada beban penuh memberikan bacaan wattmeter 100 W. Jika R_P ialah 0.3 Ω, hitung R_S.

[10 marks]

[10 *markah*]

QUESTION 4

SOALAN 4

CLO1 (a) Express the resonant frequency equation for the RLC parallel circuit.

Tentukan persamaan frekuensi salun bagi litar selari RLC.

5 marks]

[5 *markah*]

CLO1 (b) A DELTA connection is a type of connection in a three-phase system. Explain the DELTA connection in a three-phase system with the aid of a circuit diagram.

Sambungan DELTA adalah salah satu jenis sambungan dalam sistem 3 fasa. Terangkan sambungan DELTA di dalam sistem 3 fasa dengan gambar rajah litar yang berkenaan.

[5 marks]

[5 *markah*]

CLO1 (c) A 3-phase star-connected system has a line voltage of 400V and supplies a balanced load. Each phase of the load consists of a resistor of 10 Ω connected in series with an inductive reactance of 5 Ω. Calculate the phase voltage ($V_{ph)}$, phase current ($I_{ph)}$ and total power consumed by the system.

Sistem 3 fasa sambungan bintang mempunyai voltan talian sebanyak 400V dan membekalkan beban seimbang. Setiap fasa beban terdiri daripada rintangan 10 Ω yang disambung secara bersiri dengan reaktans teraruh 5 Ω. Kirakan voltan fasa, ($V_{ph)}$, *arus fasa,* I_{ph} *dan kuasa aktif keseluruhan yang digunakan oleh sistem.*

[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

A circuit consists of a 60 Ω resistor, a 30 μF capacitor, and an 80 mH inductor connected in parallel, across a 120V, 60 Hz supply. Calculate the current through the resistor (I_R), the inductor (I_L), and the capacitor (I_C), the total supply current (I_T), the total impedance (Z_T), the power factor, and the total power consumed by the circuit. Then, draw a current vector diagram to show the phase relationships among the currents.

Satu litar mengandungi perintang 60 Ω, pemuat 30 μF, dan peraruh 80 mH yang disambung secara selari kepada bekalan 120V, 60 Hz. Kirakan arus melalui perintang (I_R), peraruh (I_L), dan pemuat (I_C), jumlah arus bekalan (I_T), jumlah galangan (Z_T), faktor kuasa, dan jumlah kuasa yang digunakan oleh litar. Kemudian, lukis gambar rajah vektor arus untuk menunjukkan hubungan fasa di antara arus-arus tersebut.

[20 marks]

[*20 markah*]

SOALAN TAMAT

SENARAI FORMULA

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

$$\boldsymbol{\theta = \cos^{-1} PF = \cos^{-1} 1 = 0°}$$

$$f_L = f_r + \frac{BW}{2}$$

$$\boldsymbol{\theta = \tan^{-1}\left(\frac{X_C - X_L}{R}\right) = \tan^{-1}\left(\frac{0}{R}\right) = 0°}$$

$$\boldsymbol{\theta = \tan^{-1}\left(\frac{V_C - V_L}{V_S}\right) = \tan^{-1}\left(\frac{0}{V_S}\right) = 0°}$$

$$Q = \frac{X_L}{R} = \frac{f_r}{BW}$$

$$\boldsymbol{\cos\theta = \frac{R}{Z} = \frac{R}{R} = 1}$$

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

$$\boldsymbol{f_r = \frac{1}{2\pi\sqrt{LC}}}$$

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

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

$$\boldsymbol{Q = \frac{X_L}{R} = \frac{X_C}{R} = \frac{V_L}{V_S} = \frac{V_C}{V_S} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{f_r}{BW}}$$

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

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

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

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

$$S_1 = S_2$$

$$I_1 V_1 = I_2 V_2$$

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

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

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

$$P_1 = I_1 V_1$$

$$P_2 = I_2 V_2 \quad or \quad P_2 = I_2^2 R_L$$

$$P_1 = P_2$$

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

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

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

$$S = 3\, I_P V_P$$

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

$$V_L = V_P$$

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

$$\boldsymbol{V_P = V_R = V_Y = V_B}$$

$$V_P = V_L$$

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

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

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

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

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

$$\boldsymbol{I_P = I_L}$$

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

$$\boldsymbol{I_L = I_P}$$

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