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 : 2024/2025

DET20033: ELECTRICAL CIRCUITS

TARIKH : 13 DISEMBER 2024
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **TUJUH (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)** subjective questions. Answer **ALL** questions.

ARAHAN :
*Bahagian ini mengandungi **EMPAT (4)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 (a) List **FOUR (4)** sources of Alternating Current (AC).
*Senaraikan **EMPAT (4)** sumber Arus Ulang Alik (AU).*

[4 marks]
[*4 markah*]

CLO1 (b) Using the diagram of a simple AC generator, discuss Faraday's Law and Lenz's Law in the generation of alternating current.
Menggunakan gambarajah penjana AU ringkas, bincangkan Hukum Faraday dan Hukum Lenz dalam penghasilan arus ulang alik.

[6 marks]
[*6 markah*]

CLO1 (c) The instantaneous value of current in an AC circuit at t second is given by $I = 50 \sin (100\pi t - 0.45)$ mA . Calculate the peak current, the mean current value, the time period , frequency and the value of the current when $t = 8$ ms.
Nilai arus seketika dalam litar AU pada masa t saat diberikan sebagai $I = 50 \sin (100\pi t - 0.45)$ mA. Kirakan arus puncak, nilai arus purata, nilai tempoh masa , frekuensi dan nilai arus apabila $t = 8$ ms.

[10 marks]
[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Visualize a phasor diagram to represent the relationship between current and voltage for a purely resistive AC circuit, a purely inductive AC circuit and purely capacitive AC circuit.

Visualisasikan melalui gambarajah fasa untuk menerangkan hubungan di antara arus dan voltan bagi litar AU rintangan tulen, litar AU induktif tulen dan litar AU kapasitif tulen.

[5 marks]

[*5 markah*]

CLO1 (b) With the aid of a suitable graph, explain the relationship between capacitive reactance, X_C with frequency, f.

Dengan bantuan graf yang sesuai, terangkan hubungan antara regangan kapasitif, X_C dengan frekueansi, f.

[5 marks]

[*5 markah*]

CLO1 (c) Based on Figure A2 (c), a series resonance circuit consisting of a resistor of 25Ω, a capacitor of 120nF and an inductor of 100mH is connected across a sinusoidal supply voltage which has a constant output of 200V at all frequencies. Calculate the resonant frequency, the current at resonance, the voltage across the inductor and capacitor at resonance and the quality factor of the circuit.

Berdasarkan rajah A2 (c), satu litar resonans sesiri yang terdiri daripada perintang 25Ω, pemuat 10uF dan pearuh 100mH disambungkan ke voltan bekalan sinusoidal yang mempunyai keluaran tetap 200V pada semua frekuensi. Kirakan frekuensi salun, arus ketika salun, voltan merintangi pearuh dan pemuat ketika salun dan factor kualiti dalam litar.

[10 marks]

[*10 markah*]

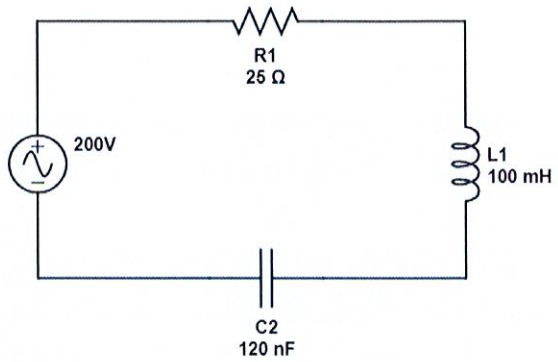

Figure A2 (c) / *Rajah A2 (c)*

QUESTION 3

SOALAN 3

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

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

[4 marks]

[*4 markah*]

CLO1 (b) Explain **THREE (3)** main parts of a transformer and its functions.

*Terangkan **TIGA (3)** bahagian utama sebuah transformer dan fungsinya.*

[6 marks]

[*6 markah*]

CLO1 (c) A 10 kVA, single-phase transformer has a turns ratio of 12:1 and is supplied by a 2.4 kV supply. Neglecting losses, calculate the full load secondary current, the minimum value of load resistance which can be connected across the secondary winding and the primary current at full load kVA.

Sebuah pengubah fasa tunggal 10 kVA mempunyai nisbah lilitan 12:1 disuap daripada bekalan 2.4 kV. Dengan mengabaikan kehilangan, kirakan arus sekunder beban penuh, nilai minimum rintangan beban yang boleh disambungkan pada belitan sekunder dan arus primer pada beban penuh kVA

[10 marks]
[*10 markah*]

QUESTION 4
SOALAN 4

CLO1 (a) Express the phenomenon of resonance.
Terangkan fenomena resonans.

[5 marks]
[*5 markah*]

CLO1 (b) DELTA is known as mesh connection. Discuss the DELTA connection in a three-phase system using appropriate circuit diagram.
DELTA dikenali sebagai sambungan sarang. Bincangkan sambungan DELTA di dalam sistem tiga fasa dengan menggunakan gambar rajah litar yang sesuai.

[5 marks]
[*5 markah*]

CLO1

(c) Three balanced loads with 15Ω of resistance and 0.05H of inductance are connected in STAR to a 415V, 3-phase supply. Calculate the line current, phase current, phase voltage and line voltage if the supply frequency is 50 Hz.

Tiga beban seimbang yang mengandungi rintangan 15Ω dan pearuh 0.05H telah disambungkan dalam bentuk penyambungan bintang ke bekalan 415V, 50Hz, 3 fasa. Kirakan arus talian, arus fasa, voltan fasa dan voltan talian jika frekuensi bekalan adalah 50 Hz.

[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 coil with an inductance of 314.8mH and resistance of 60Ω is connected in parallel with a 15μF capacitor across 200V, 50Hz supply. Calculate the current flowing through the capacitor, the current in the coil, the circuit impedance, the supply current and the power consumed.

Satu gegelung yang mempunyai kearuhan 314.mH dan rintangan 60Ω disambungkan secara selari dengan 15μF kapasitor merentasi bekalan 200V, 50Hz. Kira arus di dalam kapasitor, arus di dalam gelung, galangan litar, arus bekalan dan kuasa yang telah digunakan.

[20 marks]

[*20 markah*]

SOALAN TAMAT

SENARAI FORMULA

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

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

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

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

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

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

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

$$I_1 = \frac{N_2}{N_1} \times I_2 \qquad I_2 = \frac{V_2}{R_L}$$

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

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

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

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

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

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

$$V_P = V_R = V_Y = V_B \qquad V_P = V_L$$

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

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

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

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

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

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

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

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

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

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

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

$$S_1 = S_2$$

$$I_1 V_1 = I_2 V_2$$

$$P_1 = I_1 V_1$$

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

$$P_1 = P_2$$

$$S = 3\, I_P V_P$$

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

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

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