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 : 4 JANUARI 2024**
**MASA : 11.15 AM – 1.15 PM (2 JAM)**

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Kertas ini mengandungi **ENAM (6)** halaman bercetak.
Bahagian A : Subjektif (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)

**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 **TWO (2)** methods to generate alternating current.
*Senaraikan **DUA (2)** kaedah untuk menjana arus ulangalik..*

[4 marks]
[*4 markah*]

CLO1 (b) Explain the alternating current (AC) waveform produced by a simple alternating current generator (one loop in 2-pole magnet).
*Terangkan bentuk gelombang arus ulang alik (AC) yang dihasilkan oleh penjana arus ulang alik (AC) ringkas (satu gelung dalam magnet 2 kutub).*

[6 marks]
[*6 markah*]

CLO1 (c) An alternating current voltage is given by $v = 75 \sin (200\pi t + 0.25)$ V. Calculate the peak-to-peak voltage value, mean voltage value, time period, frequency and the value of voltage when t = 8 ms.
*Satu persamaan voltan arus ulang alik adalah $v = 75 \sin (200\pi t + 0.25)$ volt. Kirakan nilai puncak ke puncak, nilai voltan puncak, tempoh masa, frekuensi dan nilai voltan apabila t = 8 ms.*

[10 marks]
[*10 markah*]

**QUESTION 2**
***SOALAN 2***

CLO1 (a) Express the voltage and current equation for Figure 1(a), Figure 1(b) and Figure 1(c).
*Nyatakan persamaan voltan dan arus bagi Rajah 1(a), Rajah 1(b) dan Rajah 1(c)*

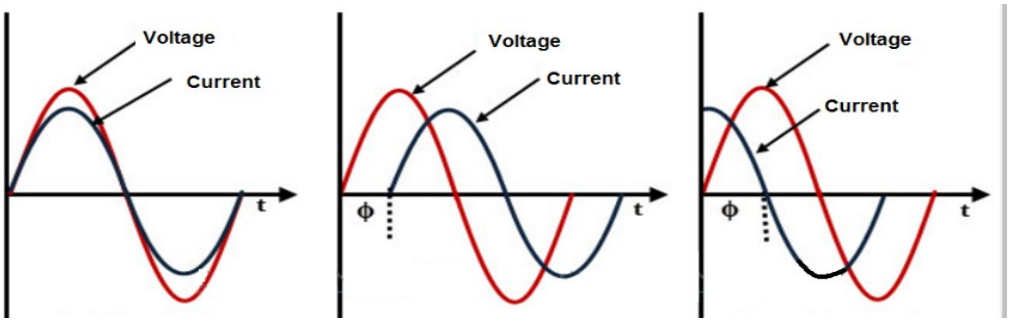


Figure 1(a) / *Rajah 1(a)*

Figure 1(b) / *Rajah 1(b)*

Figure 1(c) / *Rajah 1(c)*

[5 marks]
[*5 markah*]

CLO1 (b) Represent the active power(P),reactive power (Q), and apparent power (S) in the AC circuits using the power triangle and power formula.
*Wakilkan kuasa aktif (P), kuasa reaktif (Q) dan kuasa ketara (S) dalam litar AC menggunakan segi tiga kuasa dan formula kuasa..*

[5 marks]
[*5 markah*]

CLO1 (c) A coil inductance of 100mH is connected in series with a capacitance of 10μF and a resistance of 100Ω across a 240V, variable frequency supply. Calculate the resonant frequency, the current at resonance, voltages across inductor and capacitor at resonance and Q-factor of the circuit.

*Satu gegelung peraruh 100mH disambungkan secara siri dengan pemuat 10μF dan perintang 100Ω merintangi bekalan voltan 240V, bekalan frekuensi boleh ubah. Kira frekuensi salun, arus ketika salun, voltan merintangi pearuh dan pemuat ketika salun dan faktor-Q dalam litar.*

[10 marks]
[*10 markah*]

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

CLO1 (a) List **FOUR (4)** types of power losses in a transformer.
*Senaraikan **EMPAT (4)** jenis kehilangan kuasa dalam pengubah.*

[4 marks]
[*4 markah*]

CLO1 (b) Explain briefly about step-up and step-down transformer with the inclusion of mathematical equation of turns ratio for both transformers.
*Terangkan secara ringkas tentang pengubah langkah naik dan pengubah langkah turun dengan disertakan persamaan matematik bagi nisbah lilitan untuk kedua-dua pengubah.*

[6 marks]
[*6 markah*]

CLO1 (c) A 5kVA single phase transformer with a turns ratio 10:1 is fed from a 2.5kV supply. By neglecting losses, calculate the full load secondary current, the load resistance and the primary current at full load kVA.
*Sebuah pengubah fasa tunggal 5kVA mempunyai nisbah lilitan 10:1 disuap daripada bekalan 2.5kV. Dengan mengabaikan kehilangan, kirakan arus sekunder beban penuh, rintangan beban dan arus primer pada beban penuh kVA.*

[10 marks]
[*10 markah*]

**QUESTION 4**
***SOALAN 4***

CLO1 (a) Express the resonant frequency equation for RLC series circuits.
*Terbitkan persamaan frekuensi salun bagi litar siri RLC.*

[5 marks]
[*5 markah*]

CLO1 (b) DELTA is known as mesh connection. Discuss the DELTA connection in the three-phase system.
*DELTA dikenali sebagai sambungan sarang. Bincangkan sambungan DELTA di dalam sistem tiga fasa*.

[5 marks]
[*5 markah*]

CLO1 (c) Three identical coils with 15Ω of resistance and 0.05H of inductance are connected in STAR to a 415V, 50Hz, 3-phase supply. Calculate the line current, phase current, phase voltage and line voltage.
*Tiga gegelung yang sama dengan setiap satu mempunyai rintangan 15Ω dan peraruh 0.05H telah disambungkan dalam bentuk penyambungan bintang ke bekalan 415V, 50Hz, 3 fasa. Kirakan arus talian, arus fasa, voltan fasa dan voltan talian.*

[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 series of RLC circuit has the following values R=270Ω, C =2.5μF and L=750mH. If the circuit has maximum voltage, 60V and ω =377 with phase angle ɵ =0.6 , calculate the inductive reactance (XL), capacitive reactance (XC), total impedance, maximum current, current at t= 3.0ms and actual power for circuit.

*Satu litar siri RLC mengandungi nilai R=250Ω, C =2.5μF and L=750mH. Sekiranya litar mempunyai nilai voltan maksima 60V, ω =377 dan beza sudut ɵ =0.6 , kirakan regangan kearuahan ($X_L$), regangan kemuatan ($X_C$), jumlah galangan, nilai arus maksima, nilai arus seketika pada t=5.0ms, dan nilai power sebenar litar.*

[20 marks]
[*20 markah*]

**SOALAN TAMAT**

# SENARAI FORMULA

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

<table>
<tr><td colspan="2">$\theta = \tan^{-1}\left(\frac{X_C - X_L}{R}\right) = \tan^{-1}\left(\frac{0}{R}\right) = 0°$<br>$\theta = \tan^{-1}\left(\frac{V_C - V_L}{V_S}\right) = \tan^{-1}\left(\frac{0}{V_S}\right) = 0°$</td><td>$Q = \frac{X_L}{R} = \frac{f_r}{BW}$</td></tr>
<tr><td colspan="2">$\cos\theta = \frac{R}{Z} = \frac{R}{R} = 1$</td><td>$\eta = \frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$</td></tr>
<tr><td colspan="2">$f_r = \frac{1}{2\pi\sqrt{LC}}$</td><td>$V_2 = \frac{N_2}{N_1} \times V_1$<br>$V_2 = \frac{P_2}{I_2}$</td></tr>
<tr><td colspan="2">$Q = \frac{X_L}{R} = \frac{X_C}{R} = \frac{V_L}{V_S} = \frac{V_C}{V_S} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{f_r}{BW}$</td><td>$V_1 = \frac{N_1}{N_2} \times V_2$<br>$V_1 = \frac{P_1}{I_1}$</td></tr>
<tr><td>$I_1 = \frac{N_2}{N_1} \times I_2$</td><td>$I_2 = \frac{V_2}{R_L}$</td><td>$S_1 = S_2$<br>$I_1 V_1 = I_2 V_2$</td></tr>
<tr><td colspan="2">$Z_P = \sqrt{R^2 + X_{eq}^2}$<br>$if\ X_L > X_C;\ \ X_{eq} = X_L - X_C$<br>$if\ X_C > X_L;\ \ X_{eq} = X_C - X_L$<br>$Z_P = \frac{V_P}{I_P}$</td><td>$P_1 = I_1 V_1$<br>$P_2 = I_2 V_2 \quad or \quad P_2 = I_2^2 R_L$<br>$P_1 = P_2$</td></tr>
<tr><td>$V_L = V_{RY} = V_{YB} = V_{BR}$<br>$V_L = \sqrt{3}\, V_P$</td><td>$V_L = V_{RY} = V_{YB} = V_{BR}$<br>$V_L = V_P$</td><td>$S = 3\, I_P V_P$<br>$S = \sqrt{3}\, I_L V_L$</td></tr>
<tr><td>$V_P = V_R = V_Y = V_B$<br>$V_P = \frac{V_L}{\sqrt{3}}$</td><td>$V_P = V_L$</td><td>$P = 3\, I_P V_P \cos\theta$<br>$P = \sqrt{3}\, I_L V_L \cos\theta$</td></tr>
<tr><td>$I_P = \frac{V_P}{Z_P}$<br>$I_P = I_L$</td><td colspan="2">$I_P = \frac{V_P}{Z_P}$<br>$I_P = \frac{I_L}{\sqrt{3}}$</td></tr>
<tr><td>$I_L = I_P$</td><td colspan="2">$I_L = \sqrt{3}\, I_P$</td></tr>
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