

SULIT



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

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI JUN 2019

DET40073: POWER ELECTRONICS

TARIKH : 24 OKTOBER 2019

MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **LAPAN (8)** halaman bercetak.

Bahagian A: Struktur (4 soalan)

Bahagian B: Esei (1 soalan)

Dokumen sokongan yang disertakan : Tiada

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
C1
- (a) With the aid of a diagram of the power electronic devices, define the symbol of GTO and TRIAC.
- Dengan bantuan gambarajah komponen elektronik kuasa, tentukan simbol GTO dan TRIAK*
- [4 marks]
[4 markah]
- CLO1
C2
- (b) With the aid of a diagram of the I-V characteristics of TRIAC, explain the following operating region.
- Dengan bantuan gambarajah lengkung ciri I-V bagi TRIAK, terangkan kendalian bagi kawasan operasi berikut:*
- i. Quadrant 1
Kuadran 1
- ii. Quadrant 3
Kuadran 3
- [6 marks]
[6 markah]
- CLO1
C3
- (c) Draw the equivalent circuit for SCR using transistor and write the circuit operation of **Re-Generation** process in SCR.
- Lukiskan gambarajah litar setara untuk SCR menggunakan transistor dan tuliskan proses operasi litar **Penjanaan Semula** dalam sebuah SCR.*
- [10 marks]
[10 markah]

QUESTION 2

SOALAN 2

CLO1
C2

(a) The DC output voltage of the chopper can be varied by varying the duty cycle.

Explain the **TWO (2)** methods for varying the duty cycle to DC Converter.*Voltan keluaran AT pemanggil boleh diubah dengan mengubah kitaran tugas.**Terangkan DUA (2) kaedah untuk mengubah kitaran tugas kepada Penukar AT.*

[4 marks]

[4 markah]

CLO1
C3(b) A buck converter is supplied from a 65V battery source. Given $L = 450\mu H$, $C = 150\mu F$, $R = 25\Omega$, $f = 20kHz$ and $D = 0.5$. Calculate:*Sebuah pemanggil langkah turun dibekalkan 65V dari punca bateri. Diberi $L =$* *$450\mu H$, $C = 150\mu F$, $R = 25\Omega$, $f = 20kHz$ dan $D = 0.5$. Kirakan:*

i. Period, T

*Tempoh, T*ii. Average output voltage, V_o *Purata voltan keluaran, V_o* iii. Minimum inductor current, $I_{L(\min)}$ *Arus minimum pearuh, $I_{L(\min)}$* iv. Maximum inductor current, $I_{L(\max)}$ *Arus maksimum pearuh, $I_{L(\max)}$*

[8 marks]

[8 markah]

CLO1
C3(c) Draw the schematic circuit of Boost Chopper with RL load. Based on the circuit, sketch in details the waveform of input voltage (V_i) and output voltage (V_o)*Lukiskan litar skematik bagi Pemanggil Langkah Naik dengan beban RL.**Berdasarkan litar tersebut, lakarkan dengan terperinci gelombang bagi voltan masukan (V_i) dan voltan keluaran (V_o).*

[8 marks]

[8 markah]

QUESTION 3

SOALAN 3

CLO1
C2

- (a) The inverters can be classified according to the nature of output voltage waveform. Explain the basic concept of switching scheme in Voltage Source Inverter (VSI).
Penyongsang boleh diklasifikasikan mengikut jenis gelombang voltan keluaran. Jelaskan konsep asas skema pensuisan dalam Penyongsang Bekalan Voltan.

[4 marks]

[4 markah]

CLO1
C3

- (b) Figure A3 (b) shows the output voltage waveform of Single Phase Full Bridge Inverter with resistive load. With the aid of a circuit diagram, write its operation during $(0 < t < T/2)$ and $(T/2 < t < T)$

Rajah A3 (b) menunjukkan gelombang voltan keluaran bagi Penyongsang Satu Fasa Tetimbang Penuh dengan beban rintangan. Dengan bantuan gambarajah litar, tuliskan operasi litar ketika $(0 < t < T/2)$ dan $(T/2 < t < T)$

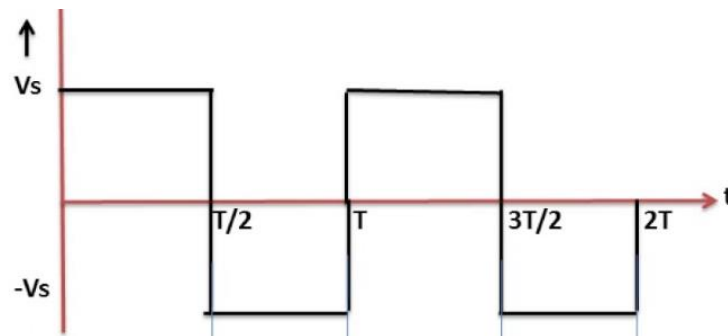


Figure A3 (b) / Rajah A3 (b)

[8 marks]

[8 markah]

CLO1
C2

(b) With the aid of a diagram, visualize the connection wiring for Single Phase Cycloconverter (Bridge Type) with resistive load.

Dengan bantuan gambarajah, gambarkan sambungan pendawaian untuk Penukar Siklo Satu Fasa (Jenis Tetimbang) dengan beban berintang.

[6 marks]

[6 markah]

CLO1
C3

(c) Single Phase Unidirectional AC Voltage Controllers with resistive load in Figure A4(c) below has a load resistance $R = 50 \Omega$, input AC supply voltage is 230V

RMS at 50Hz. If the thyristor T_1 is triggered at $\alpha = 60^\circ$, calculate :

Voltan Kawalan AU Satu Arah Satu Fasa dengan beban perintang pada Rajah A4(c) dibawah mempunyai beban perintang $R = 50 \Omega$, bekalan masukan voltan AU adalah 230V PPGD pada 50Hz. Sekiranya tiristor T_1 dipicu pada $\alpha = 60^\circ$, kirakan:

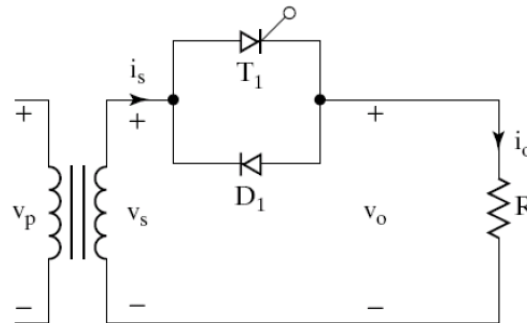


Figure A4 (c) / Rajah A4 (c)

- i. RMS output voltage
Voltan keluaran PPGD
- ii. RMS output current
Arus keluaran PPGD
- iii. Output power.
Kuasa keluaran

[10 marks]

[10 markah]

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

This section consists of **ONE (1)** essay questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **SATU (1)** soalan esei. Sila **JAWAB** semua soalan*

QUESTION 1**SOALAN 1**CLO1
C4

Figure B1 shows the Average Output Voltage, $V_{o(avg)}$ waveform for a Single Phase Half Wave Controlled Rectifier with resistive and inductive load. Given the triggering angle, α is at $\pi/6$ and extinction angle, β is at $\pi/4$. Illustrate the circuit diagram and derive the expression of average output voltage, $V_{o(avg)}$. Then, calculate the average output voltage, $V_{o(avg)}$ if input voltage is 120V. Next, investigate the method used to overcome the effect that appeared due to existence of inductance in circuit loads with added appropriate component and draw the circuit related to that method. Lastly, draw the output voltage waveform, V_o after using that method.

Rajah B1 menunjukkan gelombang Voltan Keluaran Purata, $V_{o(avg)}$, bagi sebuah Penerus Terkawal Separuh Gelombang Satu Fasa dengan beban resistif dan induktif. Diberikan sudut picuan, α adalah $\pi/6$ dan sudut lanjutan, β adalah $\pi/4$. Lakarkan rajah litar dan terbitkan ungkapan persamaan bagi voltan keluaran purata, $V_{o(purata)}$. Kemudian, kirakan voltan keluaran purata, $V_{o(purata)}$ jika voltan masukan ialah 120V. Seterusnya, siasat kaedah yang digunakan untuk mengatasi kesan yang muncul kerana kewujudan kearuhuan pada beban litar dengan menambahkan komponen yang bersesuaian dan lukiskan litar yang berkaitan dengan kaedah tersebut. Akhirnya, lukiskan gelombang keluaran voltan, V_o selepas menggunakan kaedah itu.

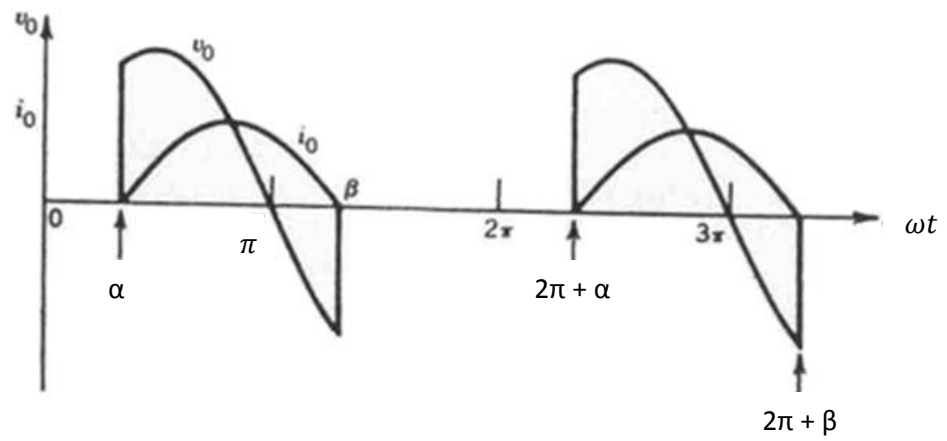


Figure B1/Rajah B1

[20 marks]

[20 markah]

SOALAN TAMAT

FORMULA DET40073

$V_{o(avg)} = \frac{V_m}{\pi}$	$V_{o(rms)} = \frac{V_m}{2}$
$V_{o(avg)} = \frac{V_m}{2\pi} (1 - \cos\beta)$	$V_{o(rms)} = \frac{V_m}{2} \sqrt{\left(\frac{\beta}{\pi} - \frac{\sin 2\beta}{2\pi}\right)}$
$V_{o(avg)} = \frac{V_m}{2\pi} (1 + \cos\alpha)$	$V_{o(rms)} = \frac{V_m}{2} \sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$
$V_{o(avg)} = \frac{V_m}{2\pi} (\cos\alpha - \cos\beta)$	$V_{o(rms)} = \frac{V_m}{2} \sqrt{\left[\frac{\beta}{\pi} - \frac{\alpha}{\pi} - \frac{\sin(2\beta)}{2\pi} + \frac{\sin(2\alpha)}{2\pi}\right]}$
$V_{o(avg)} = \frac{2V_m}{\pi}$	$V_{o(rms)} = \frac{V_m}{\sqrt{2}}$
$V_{o(avg)} = \frac{V_m}{\pi} (1 + \cos\alpha)$	$V_{o(rms)} = V_m \sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}$
$V_{o(avg)} = \frac{V_m}{\pi} (\cos\alpha - \cos\beta)$	$V_{o(avg)} = \frac{2V_m \cos\alpha}{\pi}$
$V_{o(avg)} = \frac{3\sqrt{3}}{2\pi} V_m$	$V_{o(rms)} = \sqrt{\frac{V_m^2}{2\pi} \left[\beta - \alpha - \frac{\sin(2\beta)}{2} + \frac{\sin(2\alpha)}{2}\right]}$
$V_{o(avg)} = \frac{3\sqrt{3} V_m \cos\alpha}{2\pi}$	$Z = \sqrt{R^2 + (\omega L)^2}$
$I_{Lmax} = V_o \left[\frac{1}{R} + \frac{(1-D)}{2Lf} \right]$	$I_{Lmin} = V_o \left[\frac{1}{R} - \frac{(1-D)}{2Lf} \right]$
$I_{Lmax} = \frac{V_s}{(1-D)^2 R} + \left[\frac{V_s}{2L} DT \right]$	$I_{Lmin} = \frac{V_s}{(1-D)^2 R} - \left[\frac{V_s}{2L} DT \right]$
$L_{min} = \frac{(1-D)R}{2f}$	$\Delta V_o = \frac{V_o (1-D)}{8LCf^2}$
$L_{min} = \frac{D(1-D)^2 R}{2f}$	$\Delta V_o = \frac{V_o D}{RCf}$
$V_{o(rms)} = V_s \sqrt{\frac{1}{2\pi} \left[2\pi - \alpha + \frac{\sin 2\alpha}{2} \right]}$	$V_{o(rms)} = V_s \sqrt{\frac{1}{\pi} \left[\pi - \alpha + \frac{\sin 2\alpha}{2} \right]}$