SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI JUN 2015

ET502: POWER ELECTRONICS

TARIKH : 03 NOVEMBER 2015
TEMPOH : 11.15 AM – 1.15 PM (2 JAM)

Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.
Bahagian A: Struktur (10 soalan)
Bahagian B: Esei (3 soalan)
Dokumen sokongan yang disertakan : Kertas Graf dan Rajah Gelombang Tiga Fasa

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JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A : 40 MARKS
BAHAGIAN A : 40 MARKAH

INSTRUCTION:
This section consists of **TEN (10)** structured questions. Answer **ALL** questions.

ARAHAN :
*Bahagian ini mengandungi **SEPULUH (10)** soalan struktur. Jawab **SEMUA** soalan.*

CLO1
C1

QUESTION 1
P-channel MOSFET is a power electronic device. Draw and label

(i) The symbol
(ii) The structure diagram

SOALAN 1
P-channel MOSFET adalah peranti elektronik kuasa. Lukis dan labelkan

(i) Simbol
(ii) Gambarajah struktur

[4 marks]
[4 *markah*]

CLO1
C2

QUESTION 2
Give **TWO (2)** differences between SCR and BJT.

SOALAN 2
*Berikan **DUA (2)** perbezaan antara SCR dan BJT.*

[4 marks]
[4 *markah*]

CLO1
C1

QUESTION 3
Draw and label the I-V characteristic curve of TRIAC.

SOALAN 3
Lukiskan dan labelkan ciri lengkuk I-V untuk TRIAK.

[4 marks]
[*4 markah*]

CLO2 C3

QUESTION 4

Produce the expression of the output voltage of single-phase full-wave controlled rectifier with resistive load. Given the input voltage, $V_i = V_m$ Sin wt and the triggering angle is wt=α.

SOALAN 4

Terbitkan persamaan matematik bagi voltan keluaran bagi penerus terkawal gelombang penuh satu fasa dengan beban resistif. Diberi voltan masukan, $V_i = V_m$ Sin wt dan sudut picuan wt=α.

[4 marks]
[4 *markah*]

CLO2 C3

QUESTION 5

A single-phase controlled bridge rectifier has a 50 Ω resistive load and an input voltage 240 V_{rms}, 50 Hz AC source. If the triggering angle, α is 45°, calculate:

(i) the average load voltage, V_o
(ii) the average load current, I_o

SOALAN 5

Satu penerus terkawal satu fasa jenis tetimbang mempunyai rintangan beban 50 Ω dan voltan masukan 240 V_{rms}, 50 Hz AU. Jika sudut picuan, α adalah 45°, kirakan:

(i) voltan keluaran purata, V_o
(ii) arus keluaran purata, I_o

[4 marks]
[4 *markah*]

CLO2 C2

QUESTION 6

Based on Diagram A6, with the aid of an output voltage waveform diagram, explain the operation of single-phase full-wave center-tap controlled rectifier with RL load for 0° firing angle.

SOALAN 6

Berdasarkan Rajah A6, dengan bantuan rajah bentuk gelombang voltan keluaran, terangkan operasi bagi penerus gelombang penuh terkawal satu fasa tap tengah dengan beban RL untuk sudut lengah 0°.

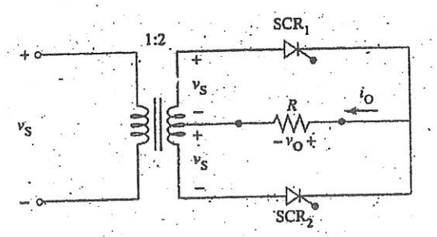

Diagram A6 / *Rajah A6*

[4 marks]
[4 *markah*]

CLO2 C3

QUESTION 7

Calculate the operation frequency, f for Buck Converter if t_{on} is 4ms, the input voltage is 80V and the output voltage is 40V.

SOALAN 7

Kirakan frekuensi, f ketika Penukar Langkah Turun beroperasi jika t_{on} 4 ms, voltan masukan 80 V dan voltan keluaran ialah 40 V.

[4 marks]
[4 *markah*]

CLO2 C3

QUESTION 8

Sketch the waveform of inductor current, I_L of Buck Converter if t_{on} = 50 ms and t_{off} = 20 ms.

SOALAN 8

Lakarkan bentuk gelombang arus peraruh, I_L bagi Penukar Langkah Turun untuk t_{on} = 50 ms dan t_{off} = 20 ms.

[4 marks]
[4 *markah*]

CLO2 C3

QUESTION 9

The single-phase full-bridge inverter has the DC supply voltage input of 120 V. The load resistance and inductive values are 8 Ω and 2 mH respectively. Calculate the:

(i) RMS output voltage, $V_{o,rms}$.
(ii) RMS output current, $I_{o,rms}$

SOALAN 9

Sebuah penyongsang satu fasa tetimbang penuh mempunyai voltan masukan AT 120V. Nilai beban rintangan masing-masing adalah 8 Ω dan 2 mH. Kirakan:

(i) voltan keluaran pmkd, $V_{o,pmkd}$
(ii) arus keluaran pmkd, $I_{o,pmkd}$

[4 marks]
[4 *markah*]

CLO2 C1

QUESTION 10

List **FOUR (4)** applications of DC to AC converter in industries.

SOALAN 10

*Senaraikan **EMPAT (4)** aplikasi penukar AT kepada AU di industri.*

[4 marks]
[4 *markah*]

SECTION B : 60 MARKS
BAHAGIAN B : 60 MARKAH

INSTRUCTION:
This section consists of **THREE (3)** essay questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **TIGA (3)** soalan esei. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 C3 (a) The operation of an SCR can be explained based on the analogy of two-transistor model.

Operasi bagi SCR boleh diterangkan berdasarkan analogi model dua-transistor.

(i) Draw and label the two-transistor model analogy circuit.

Lukis dan labelkan litar analogi model dua-transistor

[4 marks]
[*4 markah*]

(ii) Explain the regenerative action using the two-transistor model.

Terangkan operasi penjanaan semula menggunakan model dua-transistor.

[6 marks]
[*6 markah*]

CLO2 C3 (b) Figure B1 (b) is the circuit of three-phase half-wave controlled rectifier with resistive load. Based on the diagram, answer the questions below:

Rajah B1(b) adalah litar penerus separuh gelombang terkawal tiga fasa dengan beban resistif. Berdasar rajah tersebut, jawab soalan berikut:

(i) Draw the waveform of input voltage, V_{in} and output voltage, V_{out} if the firing angle, $\alpha = 30°$.

Lukiskan gelombang bagi voltan masukan, V_{in} dan voltan keluaran, V_{out} jika sudut picuan, $\alpha = 30°$.

[6 marks]
[6 *markah*]

(ii) If the input voltage $V_{in} = 132 \sin wt$, the firing angle $\alpha = 30°$ and resistive load R = 1k Ω, calculate the average output voltage ($V_{o,avg}$).

Sekiranya voltan masukan $V_{in} = 132 \sin wt$, sudut picuan $\alpha = 30°$ dan beban resistif R = 1k Ω, kirakan voltan keluaran purata ($V_{o,purata}$).

[4 marks]
[4 *markah*]

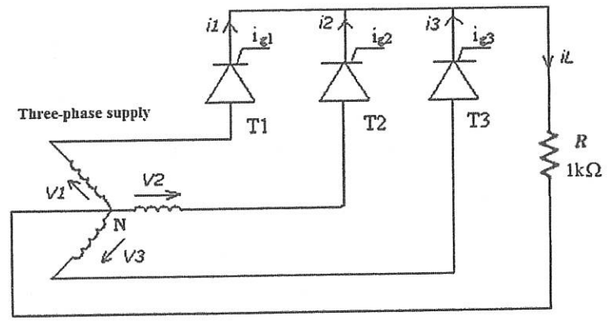

Figure B1(b) / *Rajah B1(b)*

QUESTION 2
SOALAN 2

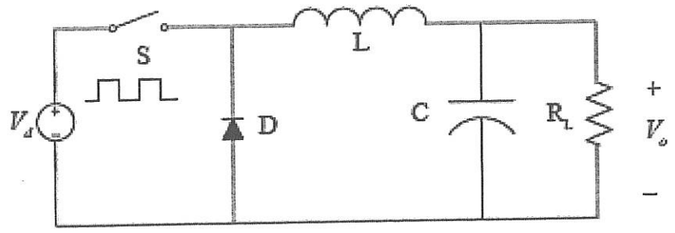

Figure B2 (a)/ *Rajah B2 (a)*

CLO2
C2

(a) Figure B2 (a) shows the schematic circuit for chopper. Based on the figure above, answer the following;

Rajah B2 (a) menunjukkan litar skematik pemenggal. Berdasarkan gambarajah di atas, jawab soalan berikut;

(i) State the above chopper type

Nyatakan jenis pemenggal diatas.

[1 mark]
[*1 markah*]

(ii) Briefly explain the circuit operation

Terangkan secara ringkas operasi litar.

[6 marks]
[*6 markah*]

(iii) Sketch and label the inductor current, I_L.

Lukis dan labelkan arus pearuh, I_L.

[3 marks]
[*3 markah*]

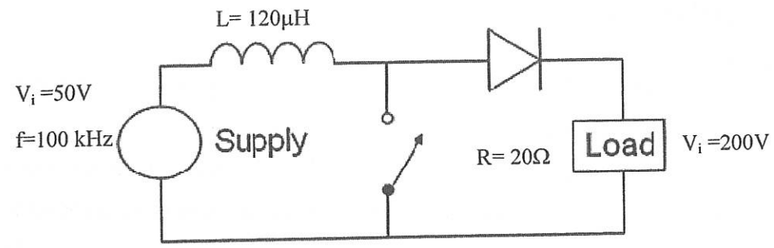

Figure B2 (b)/ *Rajah B2(b)*

CLO2
C3

(b) Figure B2 (b) shows the schematic circuit for step-up chopper. Calculate:

Figure B2 (b)menunjukkan litar skematik pemenggal langkah naik. Kirakan:

(i) the duty cycle, D

Kitar kerja, D

[2 marks]
[*2 markah*]

(ii) the minimum and maximum inductor current; I_{Lmin} and I_{Lmax}.

Arus peraruh minimum dan maksimum; I_{Lmin} dan I_{Lmax}.

[5 marks]
[*5 markah*]

(iii) If t_{on} is reduced to 6μs at constant frequency, calculate the new voltage output.

Jika t_{on} dikurangkan menjadi 6μs pada frekuensi yang sama, kirakan voltan keluaran yang baru

[3 marks]
[*3 markah*]

QUESTION 3
SOALAN 3

CLO2 C3

(a) (i) By using transistors, draw a single-phase full-wave bridge inverter with inductive load circuit.
Dengan menggunakan transistor, lukiskan litar penyongsang tetimbang 1 fasa gelombang penuh dengan beban induktif.

[3 marks]
[*3markah*]

CLO2 C3

(ii) Draw the waveform of input voltage, V_{in}; output voltage, V_o; and output current, I_o based on question (a) i.
Lukis bentuk gelombang untuk voltan masukan, V_{in}; *voltan keluaran,* V_o; *dan arus keluaran berdasarkan soalan (a) i.*

[4 marks]
[*4 markah*]

CLO2 C3

(b) (i) By using SCR, draw a circuit of the three-phase full-wave bridge inverter with resistive load.
Dengan menggunakan SCR, lukiskan litar penyongsang tetimbang tiga fasa gelombang penuh dengan beban resistif.

[5 marks]
[*5 markah*]

CLO2 C3

(ii) Draw a full cycle output waveform for:
(a) 120^0 conduction of V_{BN} and V_{BC}
(b) 180^0 conduction of V_{CA} and I_{S4}

Lukiskan satu kitar gelombang keluaran untuk:

(a) pengaliran 120^0 bagi V_{BN}, V_{BC} and I_{S3}
(b) pengaliran 180^0 bagi V_{CN}, V_{CA} and I_{S4}

[8 marks]
[*8 markah*]

SOALAN TAMAT