

SULIT



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI**

JABATAN KEJURUTERAAN ELEKTRIK

**PEPERIKSAAN AKHIR
SESI DISEMBER 2017**

DET5073 : POWER ELECTRONICS

**TARIKH : 09 APRIL 2018
MASA : 2.30 PETANG - 4.30 PETANG (2 JAM)**

Kertas ini mengandungi **TUJUH (7)** halaman bercetak.

Bahagian A: Struktur (4 soalan)
Bahagian B: Esei (2 soalan)

Dokumen sokongan yang disertakan : Tiada

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A : 60 MARKS

BAHAGIAN A : 60 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
C2

- (a) Identify the suitable regions used for Bipolar Junction Transistor to act as a switch with the aid of I-V characteristic curve.

Kenalpasti kawasan yang sesuai bagi Transistor Dwi Kutub untuk bertindak sebagai suis dengan bantuan lengkung ciri I-V.

[4 marks]

[4 markah]

CLO1
C2

- (b) Explain latching current and holding current.

Terangkan arus selak dan arus pegang.

[4 marks]

[4 markah]

CLO1
C3

- (c) Sketch the equivalent circuit for SCR by using two transistors and explain the circuit's operation.

Lakarkan gambarajah litar setara untuk SCR menggunakan dua transistor dan terangkan operasi litar tersebut.

[7 marks]

[7 markah]

QUESTION 2

SOALAN 2

CLO2
C2

- (a) Explain TWO (2) functions of freewheeling diode in half wave rectifier.
Terangkan DUA (2) fungsi diod meroda bebas dalam penerus separuh gelombang.

[2 marks]
[2 markah]

CLO2
C3

- (b) Based on Figure A2(b) below, prove that the average output voltage, V_o is $V_o(avg) = \frac{V_m}{2\pi} [\cos \alpha - \cos \beta]$. Given the single phase rectifier input voltage, $V_{in} = V_m \sin(\omega t)$.

Merujuk kepada Rajah A2(b) di atas, buktikan bahawa voltan keluaran purata adalah $V_o(avg) = \frac{V_m}{2\pi} [\cos \alpha - \cos \beta]$. Diberi voltan masukan penerus fasa tunggal, $V_{in} = V_m \sin(\omega t)$.

[5 marks]
[5 markah]

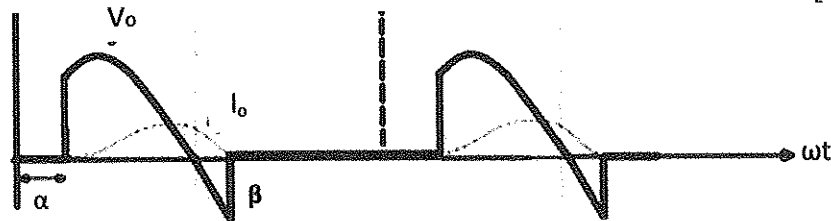


Figure A2(b) / Rajah A2(b)

CLO2
C4

- (c) Based on Figure A2(c), identify in detail the method to overcome the effects appeared due to the existence of inductor and explain the circuit operation of the method chosen with the aid of a circuit diagram.

Berdasarkan Rajah A2(c), kenalpasti secara terperinci kaedah untuk mengatasi kesan kewujudan pearuh dan terangkan operasi litar bagi kaedah yang dipilih dengan bantuan rajah litar.

[8 marks]
[8 markah]

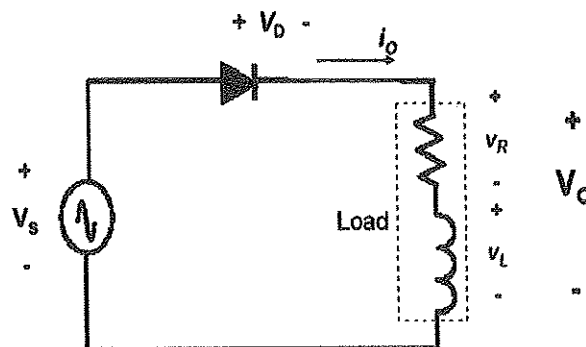


Figure A2(c) / Rajah A2(c)

QUESTION 3

SOALAN 3

CLO2
C1

- (a) State **THREE (3)** advantages of using DC to DC choppers in industry.
Nyatakan TIGA (3) kelebihan menggunakan pemenggal AT ke AT dalam industri.

[3 marks]

[3 markah]

CLO2
C2

- (b) Compare between step-down and step-up converter in terms of their circuit diagram and definition.
Bezakan diantara penukar langkah turun dan langkah naik dari segi gambarajah litar dan definisi.

[5 marks]

[5 markah]

CLO2
C3

- (c) A buck converter is supplied from a 50 V battery source. Given $L = 400\mu\text{H}$, $C = 100\mu\text{F}$, $R = 20\ \Omega$, $f = 20\text{kHz}$ and $D = 0.4$. Calculate:
- Average output voltage, V_o
 - Maximum inductor current, $I_L \text{ max.}$
 - Minimum inductor current, $I_L \text{ min.}$

Sebuah pemenggal langkah turun dibekalkan 50 V dari punca bateri. Diberi $L = 400\mu\text{H}$, $C = 100\mu\text{F}$, $R = 20\ \Omega$, $f = 20\text{kHz}$ dan $D = 0.4$. Kirakan:

- Purata voltan keluaran, V_o*
- Arus maksimum pearly, $I_L \text{ maks.}$*
- Arus minimum pearly, $I_L \text{ min.}$*

[7 marks]

[7 markah]

QUESTION 4

SOALAN 4

CLO2
C1

- (a) State
- THREE (3)**
- usage of cycloconverter in industry.

Nyatakan TIGA (3) kegunaan penukar siklo dalam industri.

[3 marks]

[3 markah]

CLO2
C2

- (b) Based on circuit in
- Figure A4(b)**
- , explain the circuit operation.

Berdasarkan litar pada Rajah A4(b), terangkan operasi litar tersebut.

[5 marks]

[5 markah]

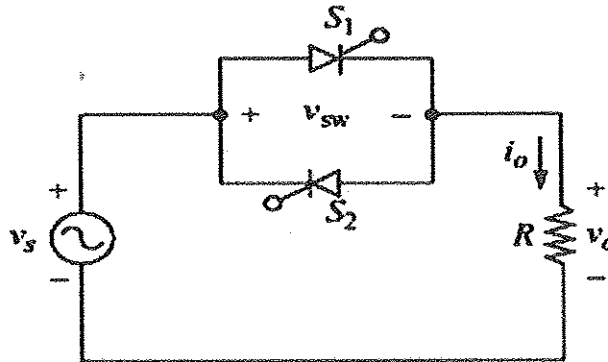


Figure A4(b) / Rajah A4(b)

CLO2
C3

- (c) A single phase full wave AC voltage regulator operates by using ON-OFF control technique. Given the voltage supply,
- $V_{i(\text{rms})} = 230\text{V}$
- ,
- 50Hz
- , and the load,
- $R=50\ \Omega$
- . If the controller is ON for 30 cycles and OFF for 40 cycles, Calculate:

- Duty cycle,
- The rms output voltage, $V_{o(\text{rms})}$ and the rms output current, $I_{o(\text{rms})}$.

Sebuah pengatur voltan AU gelombang penuh satu fasa beroperasi dengan teknik kawalan ON-OFF. Diberi nilai voltan bekalan, $V_{i(\text{ppgd})} = 230\text{V}$, 50Hz , dan beban, $R=50\ \Omega$. Sekiranya pengawal tersebut di ON selama 30 kitar dan di OFF selama 40 kitar, Kirakan:

- Kitaran kerja,*
- Voltan keluaran ppgd, $V_{o(\text{ppgd})}$ dan arus keluaran ppgd, $I_{o(\text{ppgd})}$*

[7 marks]

[7 markah]

SECTION B: 40 MARKS

BAHAGIAN B : 40 MARKAH

INSTRUCTION:

This section consists of TWO (2) essay questions. Answer ALL questions.

ARAHAN:

Bahagian ini mengandungi DUA (2) soalan esei. Jawab SEMUA soalan.

QUESTION 1

SOALAN 1

Draw a circuit for a single phase full-wave controlled bridge rectifier which has an input voltage of 230 V, 50 Hz with R-L load of 5 Ω and 10m H respectively. Based on the circuit, sketch the waveforms of input voltage (V_{in}) and output voltage (V_o).

Then, derive the expression for average value of output voltage ($V_{o_{avg}}$) and calculate the average output voltage ($V_{o_{avg}}$) for the circuit if the firing angle of thyristor, $\alpha=60^\circ$ and extinction angle, $\beta=30^\circ$. Finally, list TWO (2) advantages of bridge rectifier design over center tapped rectifier.

Lukiskan litar penerus tetimbang terkawal gelombang penuh satu fasa yang mempunyai voltan masukan 230 V, 50 Hz dengan beban R-L 5 Ω dan 10m H setiap satu. Berdasarkan litar tersebut, lakar bentuk gelombang voltan sumber (V_{in}) dan voltan keluaran (V_o).

Seterusnya terbitkan persamaan bagi nilai purata voltan keluaran ($V_{o_{purata}}$) dan kirakan voltan keluaran purata ($V_{o_{purata}}$) jika sudut picuan tiristor, $\alpha=60^\circ$ dan sudut lebihan, $\beta=30^\circ$. Akhirnya, senaraikan DUA (2) kelebihan rekabentuk penerus tetimbang berbanding penerus sadap tengah.

[20 marks]

[20 markah]

CLO 2
C3

QUESTION 2

SOALAN 2

CLO 2
C3

Figure B2 shows the circuit diagram of Single Phase Full Bridge Inverter with Resistive load. Explain the circuit operation, sketch the waveform of input voltage (V_s), output voltage (V_o) and output current (I_o) then calculate the rms output voltage ($V_{o_{rms}}$) and rms output current ($I_{o_{rms}}$) if a given DC input voltage is 50 V and the load resistance is 10 Ω .

Rajah B2 menunjukkan gambarajah litar Penyongsang Satu Fasa Tetimbang Penuh dengan beban Perintang, Terangkan kendalian litar, lakarkan gelombang bagi voltan masukan (V_s), voltan keluaran (V_o) dan arus keluaran (I_o) serta kirakan voltan keluaran punca purata ganda dua ($V_{o_{ppgd}}$) dan arus keluaran punca purata ganda dua ($I_{o_{ppgd}}$) jika voltan masukan AT diberi sebanyak 50 V dan beban rintangan sebanyak 10 Ω .

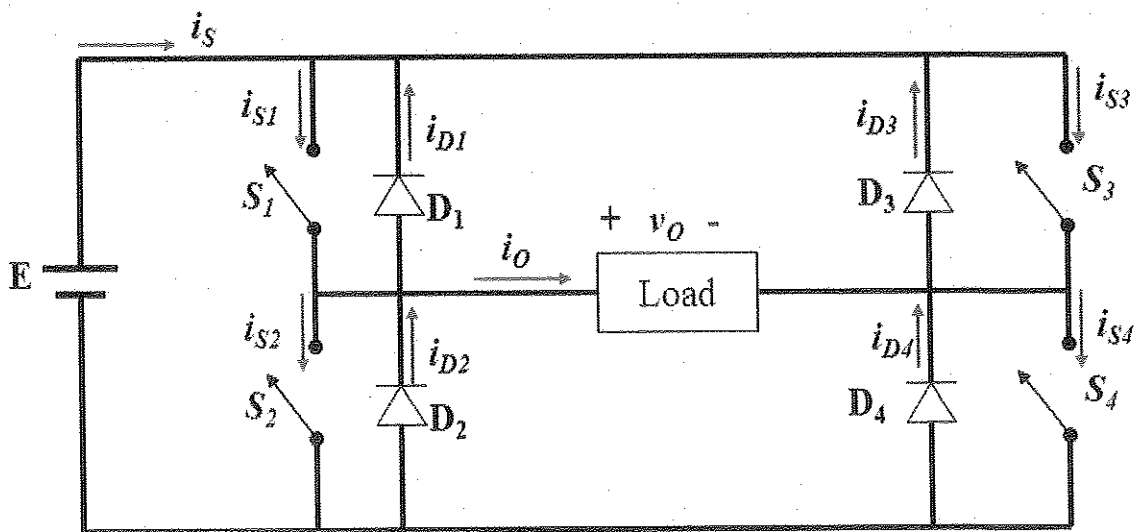


Figure B2/ Rajah B2

[20 marks]
[20 markah]

SOALAN TAMAT