SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2017

DJM5103 : POWER ELECTRONICS

TARIKH : 02 NOVEMBER 2017
MASA : 11.15 PAGI - 1.15 PETANG (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.
Struktur (4 soalan)
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan struktur. Jawab semua soalan.*

QUESTION 1

SOALAN 1

CLO1 C1 (a) Draw and label the schematic symbol and block diagram for diode.

Lukis dan label simbol skematik dan gambarajah blok bagi diod.

[5 marks]

[*5 markah*]

CLO1 C2 (b) Determine the condition of forward bias and reverse bias in a diode with the aid of a circuit diagram.

Dengan berbantukan gambarajah litar, terangkan keadaan pincang hadapan dan pincang balikan di dalam diod.

[6 marks]

[*6 markah*]

CLO1 C2 (c) Explain the function of DC converter (rectifier) and give **THREE (3)** examples of its applications.

*Terangkan fungsi penerus arus terus dan berikan **TIGA (3)** kegunaannya.*

[6 marks]

[*6 markah*]

CLO1
C3

(d) A single phase half wave controlled rectifier connected to a 150V,60 Hz source is supplying a resistive load, 10 Ω. If the delay angle α is 30^0 ,calculate;
Penerus separuh gelombang satu fasa disambungkan 150V, 60 Hz, beban perintang 10 Ω. Jika sudut picuan ialah 30^0, kirakan ;

i. maximum load current, I_m
arus beban maksimum, I_m

ii. RMS load current, I_{RMS}
arus beban purata punca ganda dua, I_{RMS}

iii. power supplied to the load
kuasa dibekalkan ke beban

[8 marks]
[8 markah]

QUESTION 2
SOALAN 2

CLO1 C3 (a) Sketch the circuit diagram and the waveform for the output voltage, V_o and output current, I_o of a step up chopper.
Lakarkan gambarajah litar dan.gelombang bagi voltan keluaran, V_o dan arus keluaran, I_o bagi pemotong langkah-naik.

[8 marks]
[*8 markah*]

CLO1 C5 (b) The DC converter (Chopper) has a resistive load of R=10 ohm and the input voltage is 220V dc. The switching frequency, *f* is 1 kHz and the duty cycle is 50%. Value :
Sebuah penukar DC (Pemenggal) mempunyai beban rintangan R=10 ohm dan voltan masukan ialah Vs = 220V dc. Frekuensi penyuisan f ialah 1 kHz dan beroperasi pada kitar tugas 50%. Nilaikan :

i. The average output voltage, V_o
Voltan purata keluaran, V_o

ii. The average output current, I_o
Arus keluaran rms, I_o

[5 marks]
[*5 markah*]

CLO1 C3 (c) A DC shunt motor 220V has an armature resistance, $R_a = 0.5\Omega$, a drop voltage f 5V and armature current, $I_a = 20A$.
Sebuah motor pirau arus terus 220V mempunyai $R_a = 0.5\Omega$ rintangan angker, 5V susut voltan dan arus angker, $I_a = 20A$.

i. Sketch the circuit diagram for DC shunt motor.
Lakarkan gambarajah litar bagi motor pirau arus terus. [4 marks]
[*4 markah*]

ii. Calculate back e.m.f.
Kirakan balikan daya gerak elektromotif. [2 marks]
[*2 markah*]

iii. Calculate armature current if back e.m.f is 185V.
Kirakan arus angker jika balikan daya gerak elektromotif adalah 185V. [2 marks]
[*2 markah*]

CLO1 C4 (d) Explain the operation of controlling a DC motor in the second quadrant in Figure 2(d).
Terangkan prinsip operasi bagi kawalan motor arus terus pada sukuan kedua seperti Rajah 2(d).

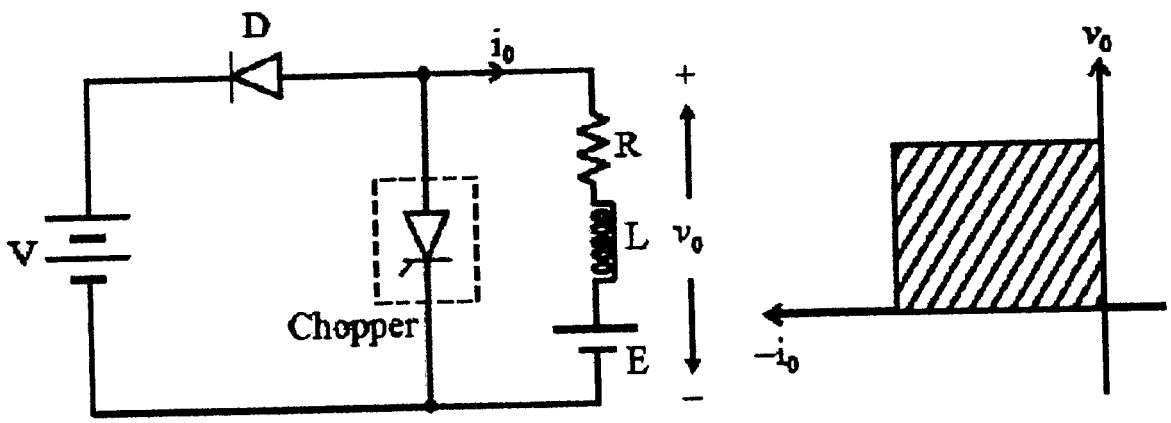

Figure 2 (d)
Rajah 2 (d)

[4 marks]
[*4 markah*]

QUESTION 3

SOALAN 3

CLO1 C2

(a) Describe the function of AC converters and identify **FOUR (4)** examples of its application.

*Terangkan fungsi penukar AC dan kenalpasti **EMPAT (4)** contoh aplikasinya.*

[6 marks]

[6 *markah*]

CLO1 C3

(b) i. Sketch and label the circuit diagram for single phase full bridge inverter circuit with resistive load.

Lukiskan dan labelkan gambarajah litar penyongsang jambatan penuh satu fasa dengan beban rintangan.

[6 marks]

[*6 markah*]

ii. Explain the operational principle of the circuit and draw the output voltage, V_o and current output, I_o waveform load. in Question 3 (b)(i).

Terangkan prinsip operasi litar dan lukiskan gelombang voltan keluaran, V_o dan arus keluaran, I_o bagi litar pada seperti di Soalan 3 (b) (i).

[4 marks]

[*4 markah*]

CLO1
C4

(c) Explain the operation of single-phase to single-phase cycloconverter and sketch the waveform for supply voltage and output voltage in Figure 3 (c).
Terangkan operasi penukar siklo satu fasa dan lakarkan gelombang voltan bekalan dan voltan keluaran di Rajah 3 (c).

[9 marks]
[*9 markah*]

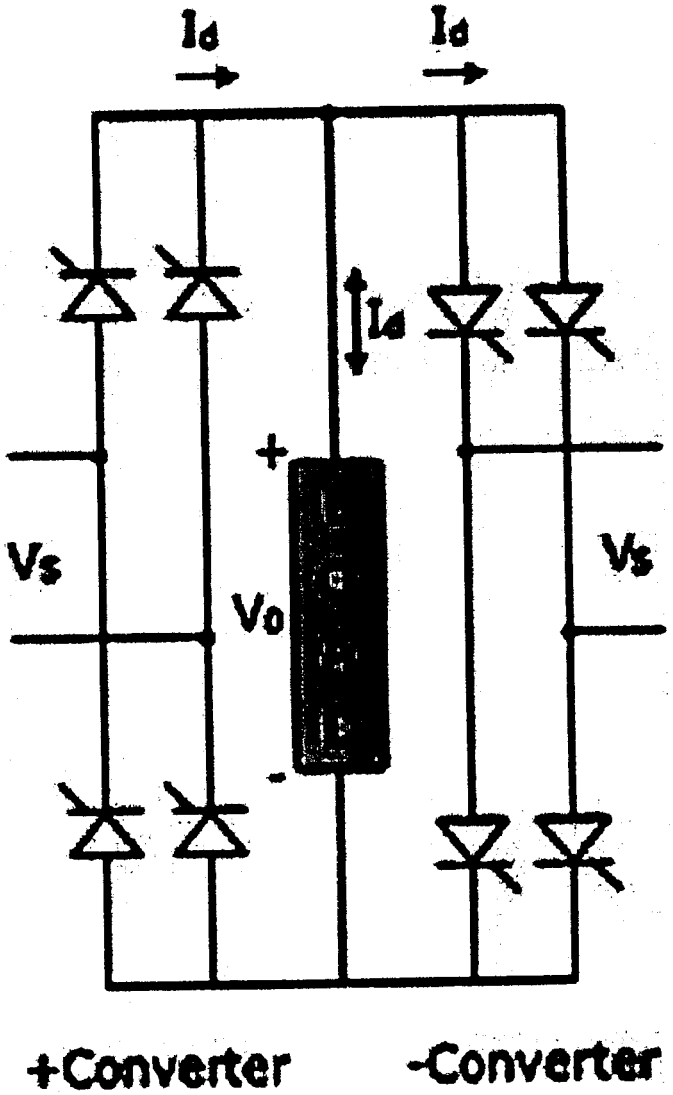

Figure 3 (c)
Rajah 3 (c)

QUESTION 4

SOALAN 4

CLO1 C2 (a) Identify **THREE (3)** main parts of DC motor and state **THREE (3)** examples of its application.

*Kenalpasti **TIGA (3)** bahagian utama motor arus terus dan senaraikan **TIGA (3)** kegunaannya di dalam industri.*

[5 marks]
[*5 markah*]

CLO1 C3 (b) A three phase induction motor has 6 poles with a full load speed of 1100 rpm and a frequency of 60 Hz. Calculate :

Sebuah motor aruhan tiga fasa 6 kutub mempunyai kelajuan penuh 1100 putaran per minit dan frekuensi 60 Hz. Kirakan :

i. Synchronous speed, Ns
Kelajuan segerak, Ns

ii. Rotor Slip, s
Gelinciran rotor, s

iii. Rotor frequency, fr
Frekuensi rotor, fr

iv. Percentage of slip
Peratus gelinciran

[10 marks]
[*10 markah*]

CLO1 C4 (c) Explain **TWO (2)** primary parts of the structure of AC motor and the basic operational of single-phase induction motor work.

*Terangkan **DUA (2)** struktur utama motor arus ulangalik dan operasi motor aruhan satu fasa bekerja.*

[10 marks]
[*10 markah*]

SOALAN TAMAT

DJM5103 : POWER ELECTRONICS
LIST OF FORMULA

Controlled half wave rectifier:

$$V_o = \frac{1}{2\pi}\int_{\alpha}^{\pi} V_m \sin(\omega t)\, d\omega t$$

$$V_o = \frac{V_m}{2\pi}[1 + \cos\alpha]$$

$$V_{o,rms} = \sqrt{\frac{1}{2\pi}\int_{\alpha}^{\pi} [V_m \sin(\omega t)]^2\, d\omega t}$$

$$V_{o,rms} = \frac{V_m}{2}\sqrt{1 - \frac{\alpha}{180} + \frac{\sin(2\alpha)}{2\pi}}$$

$$P_o = I_{rms}{}^2 . R$$

$$P_o = \frac{V_{o,rms}{}^2}{R}$$

Controlled full wave rectifier:

$$V_o = \frac{1}{\pi}\int_{\alpha}^{\pi} V_m \sin(\omega t)\, d\omega t$$

$$V_o = \frac{V_m}{\pi}[1 + \cos\alpha]$$

$$V_{o,rms} = \sqrt{\frac{1}{\pi}\int_{\alpha}^{\pi} [V_m \sin(\omega t)]^2\, d\omega t}$$

$$V_{o,rms} = V_m\sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}$$

Motor drives:

$$V_f = R_f i_f + L_f \frac{di_f}{dt}$$

$$E_g = K_v \omega I_f$$

$$V_f = \frac{2V_m}{\pi}\cos\alpha_f$$

$$I_f = \frac{V_f}{R_f}$$

$$\eta = \frac{P_{output}}{P_{input}} \text{x } 100\%$$

$$P_d = T_d \omega$$

$$T_d = K_V I_f I_a$$

$$V = E_b + I_a R_a$$

$$N_S = \frac{120\ f}{P}$$

$$\%\ s = \frac{N_s - N_r}{N_s}$$

$$f_r = s.f$$