



BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI  
KEMENTERIAN PENGAJIAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI I : 2022/2023

**DEE20023: SEMICONDUCTOR DEVICES**

**TARIKH : 20 DISEMBER 2022**

**MASA : 8.30 AM – 10.30 AM (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 : Tiada

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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  
C1
- (a) Define free electrons and holes.  
*Takrifkan istilah *free electrons* and *holes*.*
- [4 marks]  
[4 markah]
- CLO1  
C2
- (b) With the aid of a diagram, explain forward biased and reverse biased voltage supply connection across P-N junction.  
*Dengan bantuan gambarajah, terangkan voltan pincang hadapan dan pincang balikan merintang simpang P-N.*
- [6 marks]  
[6 markah]
- CLO1  
C3, DP1,  
DP3, DP4
- (c) A half wave rectifier operates with a silicon diode. Sketch the half wave rectifier circuit with input and output waveform.  
*Penerus gelombang separuh beroperasi dengan satu diod. Lukiskan litar penerus gelombang separuh berserta gelombang masukan dan keluaran.*
- [10 marks]  
[10 markah]

## QUESTION 2

## SOALAN 2

CLO1  
C1

- (a) Label the schematic symbol of Bipolar Junction Transistor (BJT) for NPN and PNP type.

*Labelkan simbol skematik Bipolar Junction Transistor (BJT) untuk jenis transistor NPN dan PNP.*

[4 marks]

[4 markah]

CLO1  
C2

- (b) With the aid of a diagram of diode I-V characteristics curve, explain forward current and reverse current.

*Dengan bantuan gambarajah diod I-V berciri lengkung, terangkan ciri-ciri lengkung I-V bagi diod, terangkan arus pincang hadapan dan arus pincang songsang.*

[6 marks]

[6 markah]

CLO1  
C3, DP1,  
DP3, DP4

- (c) The peak to peak voltage across the secondary winding for full wave center tap rectifier circuit is 210V. The load resistor,  $R_L$  is  $4.7K\Omega$  and the diode resistance is neglected. Calculate output voltage ( $V_O$ ), root means square voltage ( $V_{rms}$ ), average voltage ( $V_{avg}$ ) and average current ( $I_{avg}$ ) for this rectifier.

*Bekalan voltan puncak ke puncak merentasi gelung sekunder bagi litar penerus tap tengah gelombang penuh adalah 210V. Nilai rintangan beban  $R_L$  adalah  $4.7K\Omega$  dan rintangan diod diabaikan. Kira voltan keluaran ( $V_O$ ), voltan min punca kuasa ( $V_{rms}$ ), voltan purata ( $V_{avg}$ ) dan arus purata ( $I_{avg}$ ) bagi litar penerus tersebut.*

[10 marks]

[10 markah]

## QUESTION 3

## SOALAN 3

CLO1  
C1

- (a) State
- FOUR (4)**
- applications of SCR in semiconductor devices.

*Nyatakan EMPAT (4) aplikasi SCR dalam peranti semikonduktor.*

[4 marks]

[4 markah]

CLO1  
C2

- (b) Explain the principle operation region of n-channel JFET I-V characteristics.

*Terangkan ciri-ciri prinsip operasi bahagian n-channel JFET I-V.*

[6 marks]

[6 markah]

CLO1  
C3, DP1,  
DP3, DP4

- (c) Given
- $R_D = 2.2K\Omega$
- ,
- $R_G = 1M\Omega$
- ,
- $I_{DSS} = 10mA$
- ,
- $V_{DD} = 18V$
- and
- $V_p = -8V$
- . Calculate the
- $V_{GS}$
- ,
- $I_{DS}$
- ,
- $V_{DS}$
- ,
- $V_D$
- ,
- $V_G$
- and
- $V_S$
- of the circuit in Figure A3 (c).

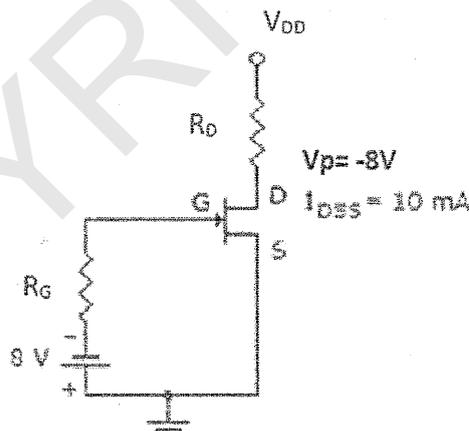
*Diberi  $R_D = 2.2K\Omega$ ,  $R_G = 1M\Omega$ ,  $I_{DSS} = 10mA$ ,  $V_{DD} = 18V$  and  $V_p = -8V$ . Kirakan  $V_{GS}$ ,  $I_{DS}$ ,  $V_{DS}$ ,  $V_D$ ,  $V_G$  dan  $V_S$  untuk litar di dalam Rajah A3 (c).*

Figure A3 (c) / Rajah A3 (c)

[10 marks]

[10 markah]

## QUESTION 4

## SOALAN 4

CLO1  
C1

- (a) Give the physical structure and schematic symbol of TRIAC and DIAC.

*Berikan struktur fizikal dan simbol skematik bagi TRIAC dan DIAC.*

[4 marks]

[4 markah]

CLO1  
C2

- (b) Silicon Controlled Rectifier (SCR) is a component with four-layers, three-junctions and a three-terminal device. Discuss how to turn on and turn off the Silicon Controlled Rectifier (SCR).

*Silicon Controlled Rectifier (SCR) adalah komponen yang mempunyai empat lapisan, tiga simpang dan tiga terminal. Bincangkan bagaimana untuk menghidup dan mematikan Silicon Controlled Rectifier (SCR).*

[6 marks]

[6 markah]

CLO1  
C3, DP1,  
DP3, DP4

- (c) A Bipolar Junction Transistor (BJT) is a three-terminal semiconductor device consisting of two p-n junctions. BJT has three terminals which are base, collector and the emitter. Demonstrate the basic operations of BJT.

*Transistor Persimpangan Bipolar (BJT) adalah peranti semikonduktor tiga terminal yang mempunyai dua simpang p-n. BJT mempunyai tiga terminal iaitu tapak, pengumpul dan pengeluar. Tunjuk cara operasi asas BJT.*

[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 berikut.

**QUESTION 1****SOALAN 1**

CLO1  
C3, DP1,  
DP3, DP4

The DC Load Line of BJT Biasing Circuit is the line that represents all the DC operating points of the transistor. Q point is the operating point which determine the working point of a transistor. Figure B1 shows the Common Emitter configuration. Calculate  $I_B$ ,  $I_{CQ}$ ,  $V_{CQ}$ ,  $I_{C(sat)}$ , and  $V_{C(cut\_off)}$ . Given the value of  $\beta = 60$  and  $V_{BE} = 0.3V$ . Draw the DC load line.

Garis Beban AT Litar Bias BJT adalah garis yang mewakili semua titik operasi DC pada transistor. Titik Q ialah titik yang menentukan operasi transistor. Rajah B1 menunjukkan konfigurasi 'Common Emitter', Kirakan  $I_B$ ,  $I_{CQ}$ ,  $V_{CQ}$ ,  $I_{C(sat)}$  dan  $V_{C(cut\_off)}$ . Diberikan nilai  $\beta = 60$  dan  $V_{BE} = 0.3V$ . Lukis garis beban AT.

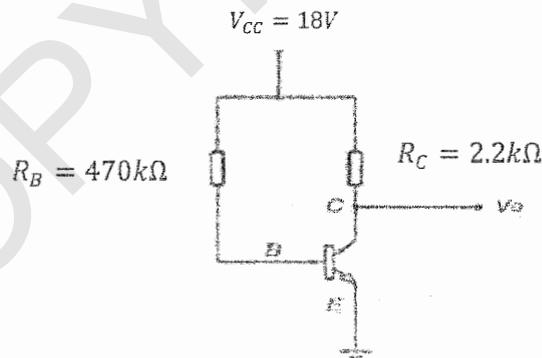


Figure B1/ Rajah B1

[20 marks]

[20 markah]

**SOALAN TAMAT**