SAS Code
MST

2017/2018 SEMESTER TWO MID-SEMESTER TEST

Diploma in Aerospace Electronics (DASE) 1st Year FT
Diploma in Energy Systems and Management (DESM) 1st Year FT
Diploma in Computer Engineering (DCPE) 1st Year FT
Diploma in Electrical & Electronic Engineering (DEEE) 1st Year FT
Common Engineering Programme (DCEP) 1st Year FT
Diploma in Engineering with Business (DEB) 2nd Year FT

PRINCIPLES OF ELECTRICAL & ELECTRONIC ENGINEERING II

Time Allowed: 1½ Hours

Instructions to Candidates

1. The Singapore Polytechnic Examination Rules are to be complied with.

2. This paper consists of **TWO** sections:
   Section A - 10 Multiple Choice Questions, 3 marks each.
   Section B - 5 Short Questions, 14 marks each.

3. **ALL** questions are **COMPULSORY**.

4. All questions are to be answered in the answer booklet. Start each question in Section B on a new page.

5. Fill in the Question Numbers, in the order that it was answered in the boxes found on the front cover of the answer booklet under the column "Question Answered".

6. This paper consists of 7 pages (inclusive of the cover page and the formulae sheet).

SECTION A

MULTIPLE CHOICE QUESTIONS [3 marks each]

1. Please **tick** your answers in the **MCQ box** on the second page of the answer booklet.
2. No marks will be deducted for incorrect answers.

A1. Which one of the following materials has the highest conductivity?

(a) Intrinsic silicon
(b) Glass
(c) N-type silicon
(d) Germanium

A2. A Zener diode is normally operated

(a) in the forward biased region.
(b) in the reverse biased avalanche breakdown region.
(c) in the reverse biased region.
(d) in the high voltage region.

A3. For the circuit shown in Figure A3, current I in the silicon diode is equal to

(a) 0.36 mA
(b) 0.48 mA
(c) 0.72 mA
(d) 1.43 mA

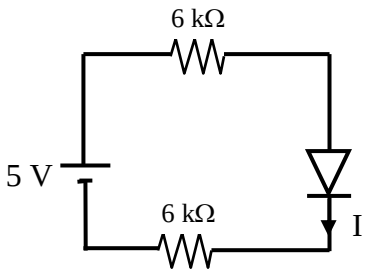

Figure A3

A4. Which one of the following devices has a negative temperature coefficient?

(a) Light emitting diode
(b) Thermistor
(c) PN junction diode
(d) Photodiode

A5. The output waveform of a power supply filter is a dc voltage of 32 V with a small ripple superimposed on it. The peak-to-peak value of the ripple is 1 V. The ripple factor is equal to

(a) 0.45%
(b) 0.9%
(c) 1.8%
(d) 3.12%

A6. For the transistor circuit shown in Figure A6, the emitter current I_E is equal to

(a) 18.33 mA
(b) 22.22 mA
(c) 25.11 mA
(d) 66.66 mA

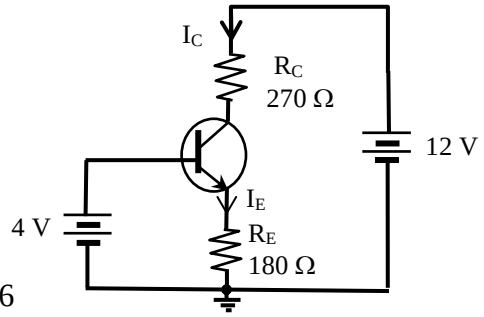

Figure A6

A7. Which one of the following devices is often used as a transducer in an automatic lighting circuit?

(a) Zener diode
(b) Moisture sensor
(c) Light dependent resistor
(d) Thermistor

A8. Which one of the following statements best describes the purpose of the relay coil shown in Figure A8?

(a) To function as an electronic switch.
(b) To amplify the voltage across the relay coil.
(c) To eliminate the use of collector resistor.
(d) To activate the relay contact.

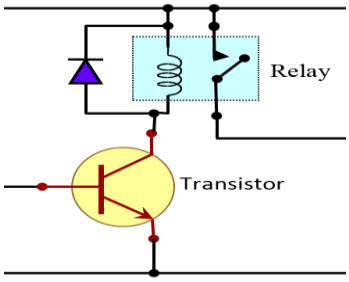

Figure A8

A9. Which one of the following statements best describes the purpose of the transistor shown in Figure A8?

(a) To provide a buffer for the input signal.
(b) To function as an electronic switch.
(c) To amplify the voltage across the relay coil.
(d) To protect the relay coil from damage.

A10. The freewheeling diode connected across the relay coil shown in Figure A8 will be forward biased when

(a) the current in the relay coil reaches its maximum value.
(b) the current in the relay coil is increased.
(c) a current flows in the relay coil.
(d) the base current of the transistor is suddenly cut off.

SECTION B (14 marks each)

B1. For the circuit shown in Figure B1,

(a) state with reason whether the diode is reverse biased or forward biased. Support your answer with calculations. [6 marks]

(b) calculate the currents flowing through resistors R_1 and R_2. Indicate the directions of both currents. [6 marks]

(c) calculate the current flowing through the silicon diode. [2 marks]

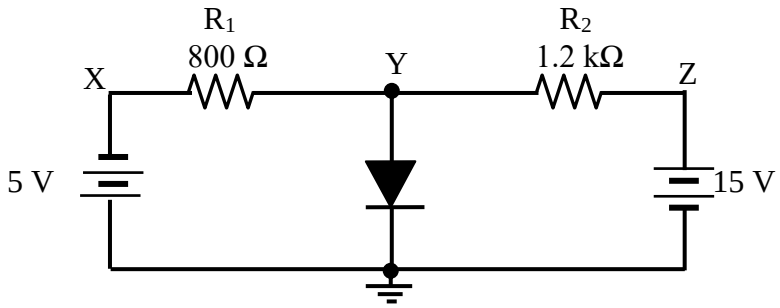

Figure B1

B2. (a) A Zener diode has an impedance of 9 Ω and a voltage of 3 V at a current of 75 mA. Calculate the operating voltage of the Zener diode if it has an operating current of 50 mA. [4 marks]

(b) Explain the operation of the circuit shown in Figure B2 and calculate the resistance of R. Assume that the LED used in the circuit has a forward voltage drop of 1.8 V. [10 marks]

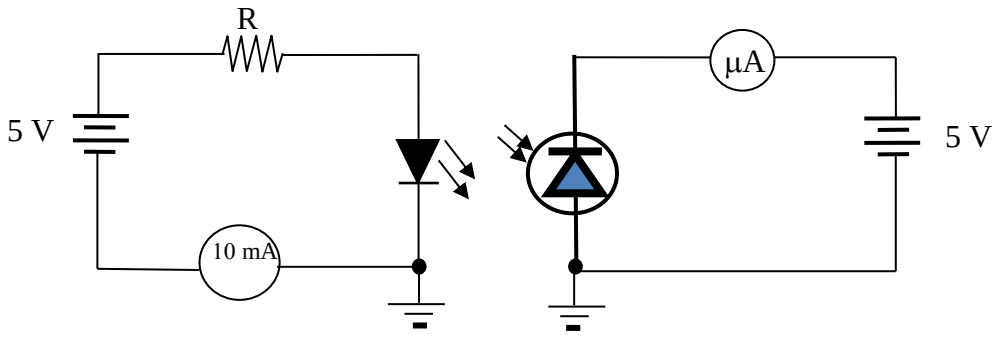

Figure B2

B3. For the circuit shown in Figure B3,

(a) state the type of rectifier circuit shown. [2 marks]

(b) calculate the peak voltage of the secondary coil. [4 marks]

(c) calculate the peak current flowing through the load resistor, R_L. [2 marks]

(d) calculate the PIV for each diode. [3 marks]

(e) calculate the turns ratio of the transformer. [3 marks]

Assume that the diodes used are silicon diodes.

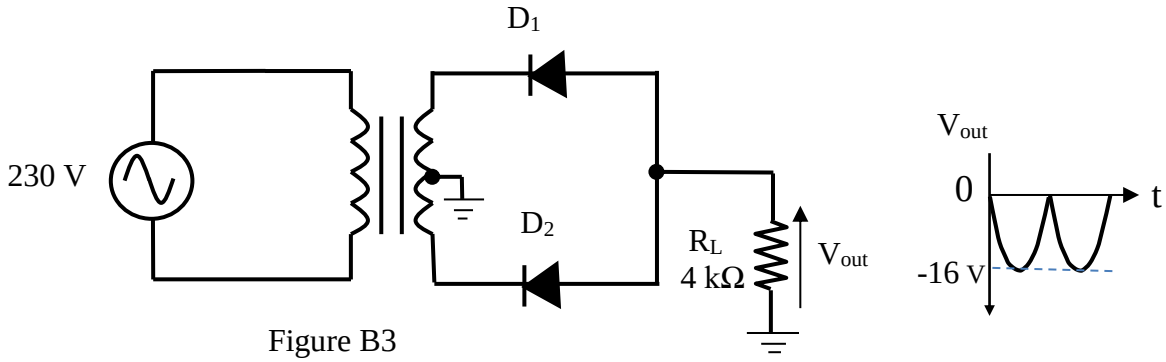

Figure B3

B4. (a) For the circuit shown in Figure B4-A, sketch the output voltage waveform across the resistor R_L. Indicate the maximum and minimum values of the waveform. The circuit uses silicon diodes. [6 marks]

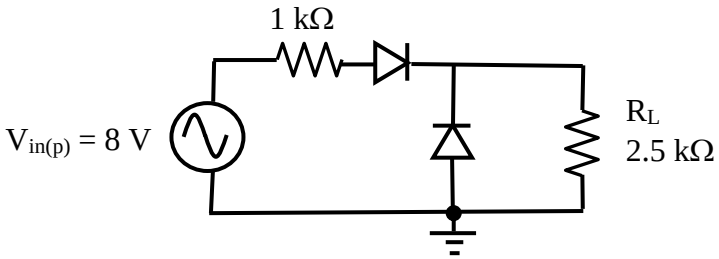

Figure B4-A

B4. (b) Figure B4-B shows a block diagram of a dc power supply. Identify the blocks A, B, C and D. [8 marks]

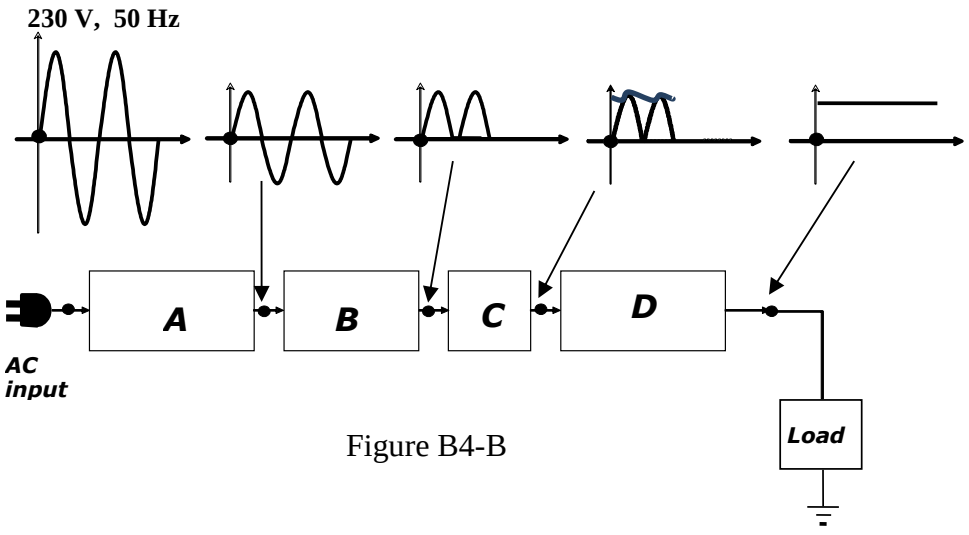

Figure B4-B

B5. The transistor circuit shown in Figure B5 is biased in the active region. Given that the current gain β_{DC} is 180 and the forward voltage drop of the LED is 2 V, calculate

(a) the current gain α_{DC}. [2 marks]

(b) the current flowing in the LED. [5 marks]

(c) the voltage V_{CE}. [4 marks]

(d) the minimum V_{CC} to main the brightness of the LED when V_{CE} = 0.2 V. [3 marks]

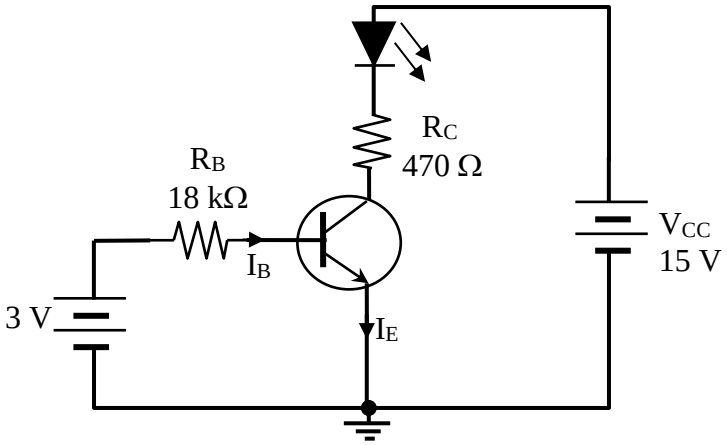

Figure B5

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Formulae

Energy, Work Done, Charge, Power:

W = QV $\quad$ P = $\frac{W}{t}$ $\quad$ I = $\frac{Q}{t}$

The maximum number of electrons in a shell (band) = $2N^2$

6.25×10^{18} electrons ➔1C of negative charge

Diodes:

Forward voltage drop V_F is 0.7 V for silicon diode and 0.3 V for germanium diode

Zener dynamic resistance $Z_Z = \frac{\Delta V_Z}{\Delta I_Z}$

AC Voltages and Currents:

$I_{rms} = I_p / \sqrt{2} = 0.7071\ I_p$ $\quad$ $I_{p\text{-}p} = 2I_p$ $\quad$ $I_{avg} = 2I_p / \pi = 0.637 I_p$

$V_{rms} = V_p / \sqrt{2} = 0.7071\ V_p$ $\quad$ $V_{p\text{-}p} = 2V_p$ $\quad$ $V_{avg} = 2V_p / \pi = 0.637 V_p$

Half-Wave Rectifier:

$V_{out(p)} = V_{sec(p)} - 0.7V$ $\quad$ $V_{AVG} = \frac{V_{out(p)}}{\pi}$ $\quad$ $PIV = V_{sec(p)}$

Centre-Tapped Full-Wave Rectifier:

$V_{out(p)} = \frac{V_{sec(p)}}{2} - 0.7V$ $\quad$ $V_{AVG} = \frac{2V_{out(p)}}{\pi}$ $\quad$ $PIV = 2V_{out(p)} + 0.7V$

Full-Wave Bridge Rectifier:

$V_{out(p)} = V_{sec(p)} - 1.4\ V$ $\quad$ $V_{AVG} = \frac{2V_{out(p)}}{\pi}$ $\quad$ $PIV = V_{out(p)} + 0.7\ V$

Ripple Factor:

$r = \frac{V_{r(rms)}}{V_{DC}}$ where $V_{r(rms)} = \frac{V_{r(p-p)}}{2\sqrt{3}}$

Line Regulation = $\left(\frac{\Delta V_{OUT}}{\Delta V_{IN}}\right)100\%$ $\quad$ **Load Regulation** = $\left(\frac{V_{NL} - V_{FL}}{V_{FL}}\right)100\%$

Transistors:

$I_E = I_C + I_B$ $\quad$ $\beta_{DC} = \frac{I_C}{I_B}$ $\quad$ $\alpha_{DC} = \frac{I_C}{I_E}$ $\quad$ $\beta_{DC} = \frac{\alpha_{DC}}{1 - \alpha_{DC}}$

$V_{BE} = 0.7V$ $\quad$ $V_{CC} = V_{CE} + I_C R_C$

$V_{BB} = V_{BE} + I_B R_B$ $\quad$ $V_{CE} = V_{CB} + V_{BE}$

ANSWERS

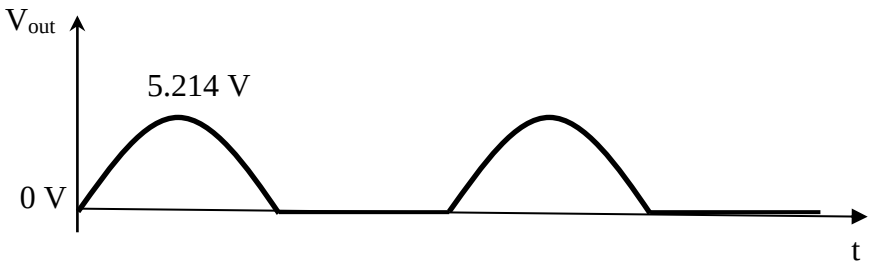
A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
C	C	A	B	B	A	C	D	B	D

B1(a) $V_Y = 3$ V Diode forward biased.
(b) $I_{YX} = 7.125$ mA $I_{ZY} = 11.917$ mA (c) 4.792 mA

B2(a) 2.775 V (b) 320 Ω

B3(a) Centre-tapped full-wave rectifier
(b) 33.4 V (c) 4 mA (d) 32.7 V (e) 0.103

B4(a)



B4(b) step-down transformer, full-wave rectifier, filter, voltage regulator

B5(a) 0.9945 (b) 23 mA (c) 2.19 V (d) 13.01 V