2004 VCE VET: Electronics GA 2: Written examination

GENERAL COMMENTS

The 2004 examination was based on the VCE VET modules within Units 3 and 4. These modules are:

- NE178 DC Power Supplies
- VBB221 Analogue Systems
- VBB222 Digital and Systems
- NE179 Digital Electronics 1
- VBB229 Mathematics for Electronics 2.

The examination paper was divided into three sections: 'DC Power Supplies', 'Analogue Systems' and a combined section of 'Digital Electronics 1' and 'Digital Systems'. There was no separate section for 'Mathematics for Electronics 2', as an understanding of mathematics was incorporated into many of the questions.

The examination contained a variety of question types: multiple-choice, short answer questions and those requiring drawings, waveforms or diagrams.

Students were able to gain full marks for the questions requiring a calculation if the correct answer was given with correct units. Some questions specifically asked that students state the formula used, and show the substitution and correct workings to achieve full marks.

Many responses seemed to indicate that students had not undertaken enough practical exercises or product construction activities during Units 3 and 4. It was also a concern that some students showed a poor understanding of basic electronic industry skills. These topics should have been comprehensively taught in Units 1 and 2 so that students were confident in applying them in the assessment tasks for Units 3 and 4, where they form part of the underpinning knowledge and skills.

SPECIFIC INFORMATION

Section 1 – DC power supplies

Question 1a–b

Marks	0	1	2	Average
%	21	38	41	**1.2**

1a
Stage C is the filter stage.

1b
A: a constant DC voltage level when the load is variable.

Question 2a–b

Marks	0	1	2	Average
%	34	26	40	**1.1**

2a
A range of answers were acceptable, including:

- bridge rectifier
- rectifier
- wheatstone rectifier.

2b
100 Hz

Question 2c

Marks	0	1	2	3	Average
%	56	8	3	33	**1.1**

$V_{pk} = (\sqrt{2} \text{ x } Vs) – (Vd)$
$= \sqrt{2} \text{ x } 12 – (2 \text{ x } 1)$
$= 16.97 – 2$
$= 14.97$ volts

Depending on how the students deducted the two volts voltage drop and the level of accuracy, the answer could vary between 14.4 and 15 volts. Full marks were awarded for answers within this range. The correct way to solve the calculation was to deduct the voltage drop after the peak voltage had been determined.

Also accepted was:
$V_{pk} = (\sqrt{2} \text{ (} Vs – Vd)$
$= \sqrt{2} \text{ x } (12– 2)$
$= 14.4$ volts

Question 2d

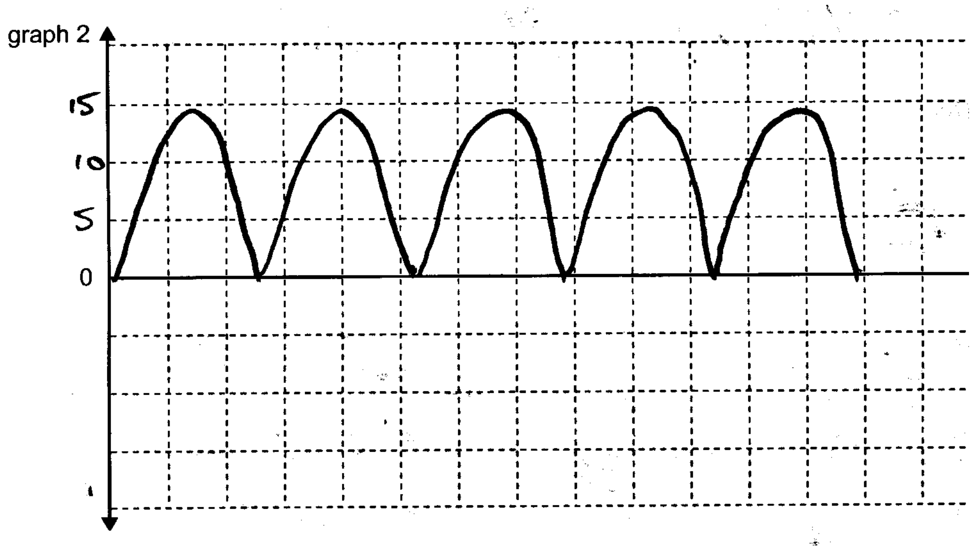
Marks	0	1	2	3	Average
%	54	10	6	30	1.2

$I = \frac{V}{I}$
$= \frac{14.97}{1k}$
$= 15mA$

Question 2e–f

Marks	0	1	2	3	Average
%	24	35	32	10	1.3

2e



Full marks were awarded if an incorrect voltage (as determined in the previous answer) was used, if it was applied correctly.

One mark was awarded for the correct Vpk, as determined in Question 2e (if solved correctly it would be very close to 15 volts). The second mark was awarded for showing the correct waveform shape (raw pulsating DC).

2f
Two conducting diodes.

Question 2g–i

Marks	0	1	2	3	4	Average
%	15	26	28	20	11	**1.9**

2g
Excessive current will flow, which could result in the transformer burning out.

2h
A fuse.

2i
C: between nodes E – F.

Question 3a–b

Marks	0	1	2	Average
%	34	34	33	**1.0**

3a
5 volts

The output voltage of the LM309 was clearly stated in bold print on the data sheet as a 5 volt regulator. Many students responded incorrectly with the answer 9 volts.

3b
Zener diode

Question 3c

Marks	0	1	2	Average
%	58	4	38	**0.8**

$V_{pk} = 8 \times \sqrt{2}$
$= 11.3V$

Question 3d

Marks	0	1	2	Average
%	25	13	63	**1.4**

Increased current will lead to an increase in power dissipation and an increase in heat energy. A heat sink would help conduct this energy to the atmosphere, keeping the regulator cooler and preventing thermal shutdown of the device.

Most students had a reasonable understanding of the function of a heat sink.

Question 4

Marks	0	1	Average
%	34	66	**0.7**

A great range of answers was accepted here. A common response was a laptop computer power supply.

Question 5a

Marks	0	1	2	3	Average
%	35	12	9	44	**1.6**

Power in load $= V_{out} \times I_{out}$
$= 6 \times (200 \times 10^{-3})$
$= 1.2W$ or $1200mW$

Students did not receive full marks if 6 was multiped by 200, providing the answer 1200 Watts.

Question 5b

Marks	0	1	2	3	Average
%	62	7	2	28	**1.0**

Power dissipated by regulator = (input voltage – output voltage) x I_{out}
= (10.8 – 6) x (200×10^{-3})
= 960mW

Question 5c

Marks	0	1	2	Average
%	86	4	10	**0.3**

The high gain of the internal error amp in the regulator may cause high frequency oscillations in certain conditions, such as when components are located several centimetres away from the terminals of the regulator. A low value RF cap in close proximity to the regulator will introduce phase changes and help reduce high frequency instability.

This question required a high level of understanding and was answered correctly by only a small number of students.

Section 2 – Analogue systems

Question 1a–c

Marks	0	1	2	3	4	Average
%	12	23	23	18	23	**2.2**

1a
Amplitude modulation, or AM.

1b
Radio Frequency.

1c
Selects the radio frequency, or tunes the radio frequency.

Question 1d–e

Marks	0	1	2	Average
%	27	37	36	**1.1**

1d
B: recover the original audio.

1e
C: pass only audio signals.

Question 2a

Marks	0	1	2	Average
%	33	34	34	**1.0**

i.
Computer Aided Design
ii.
Any CAD package was accepted; it did not have to be a PCB CAD package. Acceptable answers included: Protel, Easytrax, TurboCAD, TriCAD and ProDesktop.

The answer EDA Client, as read from the diagram on the examination paper, was not accepted.

Question 2b–c

Marks	0	1	2	3	Average
%	23	25	39	13	**1.4**

2b
To provide RF shielding.

This question required a higher level of understanding and was not generally answered correctly. The expected response was that the 'grounded copper' performed the general function of a ground plain, providing RF shielding to the surrounding components. Some students responded that it could be used as a heat sink for the components – this answer was also accepted.

2c
- wide tracks: carry the larger current in this section
- spacing: stops arcing or shorts between tracks in the 240V section of the PCB.

Question 3

Marks	0	1	2	3	4	Average
%	8	5	14	23	50	**3.1**

LED	√		6 volt lamp	√
Disc capacitor			3 volt solar cell	√
BC548 Transistor			Link wire	
Thermocouple	√		LM741C (Op Amp)	

Only four ticks were required, and students had marks deducted for any more than four ticks; i.e. it was not possible to tick everything and get full marks.

Question 4a–b

Marks	0	1	2	3	Average
%	38	31	17	13	**1.1**

4a
Electrolytic capacitor was the preferred answer; however, tantalum capacitor was accepted as it is also polarised.

4b
i.
It provides protection for the circuit if the polarity of the battery is accidentally reversed.
ii.
The diode will only allow current to flow from the positive connection, thus blocking any reverse connection.

Question 4c–e

Marks	0	1	2	3	Average
%	34	32	27	8	**1.1**

4c
Nothing, the circuit should function normally.

A few students commented that a slightly higher voltage would be applied to the circuit, and essentially nothing else would happen, as the circuit functions normally. Students who said that the circuit would blow up did not gain any marks.

4d
A variety of answers was accepted, including: pots, trim pots, potentiometers and variable resistors. A response of resistors alone was not accepted.

4e
A: the wipers would be moved up towards X.

Question 4f

Marks	0	1	2	3	Average
%	47	29	11	13	**0.9**

i.

$$f = \frac{1}{T}$$

$$= \frac{1}{\left(50 \times 10^{-3}\right) \times 4}$$

$$= 5\text{HZ}$$

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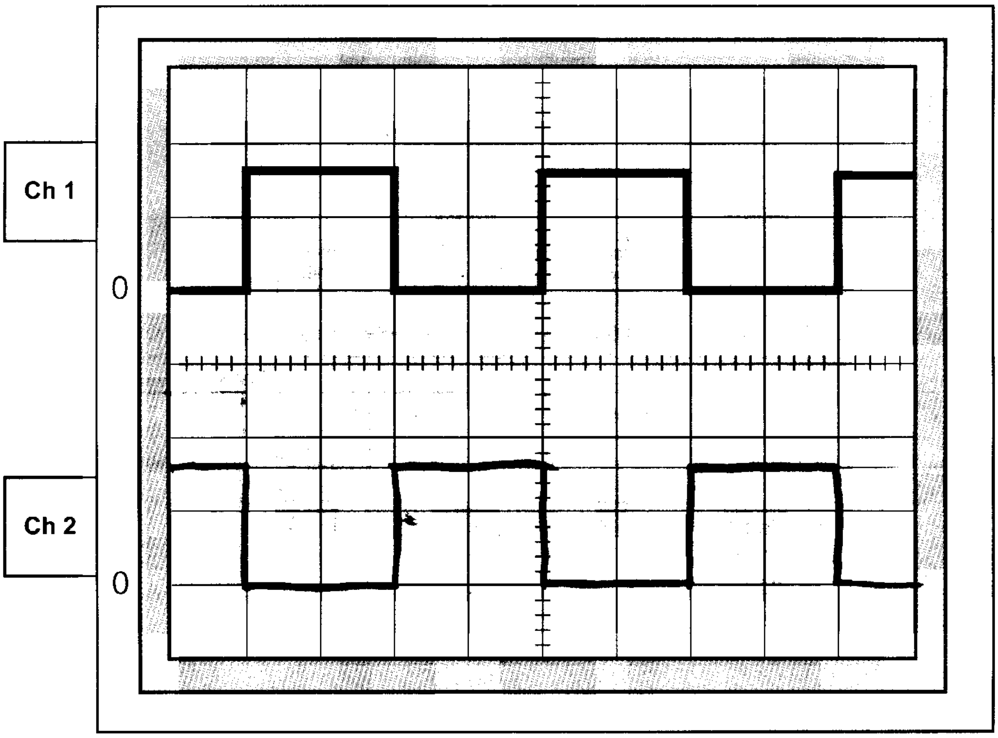
ii.
8 volts

At 5 volts per centimetre, the peak voltage needed to be determined to be close to 8 volts. Some minor differences either way were accepted, to allow for errors in reading the CRO screen.

Question 4g

Marks	0	1	2	Average
%	40	34	26	**0.9**



Question 5a

Marks	0	1	2	3	Average
%	40	22	13	25	**1.2**

$$f = \frac{1.44}{C1 \times (RA + 2RB)}$$

$$= \frac{1.44}{22 \times 10^{-6}\left(22 \times 10^{3} + \left(2 \times 22 \times 10^{3}\right)\right)}$$

= 1 HZ or 0.99 HZ

For full marks to be awarded, the formula, substitution and correct units all had to be shown.

Question 5b–c

Marks	0	1	2	Average
%	28	61	10	**0.8**

5b
9 volts

5c
4.5 – 18 volts

This could simply be read from the data sheet provided.

Section 3 – Digital electronics 1 and Digital systems

Question 1a–b

Marks	0	1	2	3	4	Average
%	32	23	19	21	4	**1.4**

1a

Increase resistance R1 or increase capacitance C1.

The specific resistor or capacitor had to be identified to receive full marks.

1b

i.

CMOS

ii.

Use an earth strap or earthed workstation. Other ESD minimisation techniques were also accepted.

Question 1c

Marks	0	1	2	Average
%	17	18	65	**1.5**

CD4017B LED Outputs							
LED 1	***LED 2***	***LED 3***	***LED 4***	***LED 5***	***LED 6***	***LED 7***	***LED 8***
Count 1. Decoded Output ‘0’	**Count 2. Decoded Output ‘1’**	**Count 3. Decoded Output ‘2’**	**Count 4. Decoded Output ‘3’**	**Count 5. Decoded Output ‘4’**	**Count 6. Decoded Output ‘5’**	**Count 7. Decoded Output ‘6’**	**Count 8. Decoded Output ‘7’**
Pin 3	**Pin 2**	**Pin 4**	**Pin 7**	Pin 10	Pin 1	Pin 5	Pin 6

Question 1d

Marks	0	1	2	3	4	5	6	Average
%	37	21	10	16	6	8	2	**1.7**

i.

‘Count 9’ or ‘Decoded output 8’ were accepted.

ii.

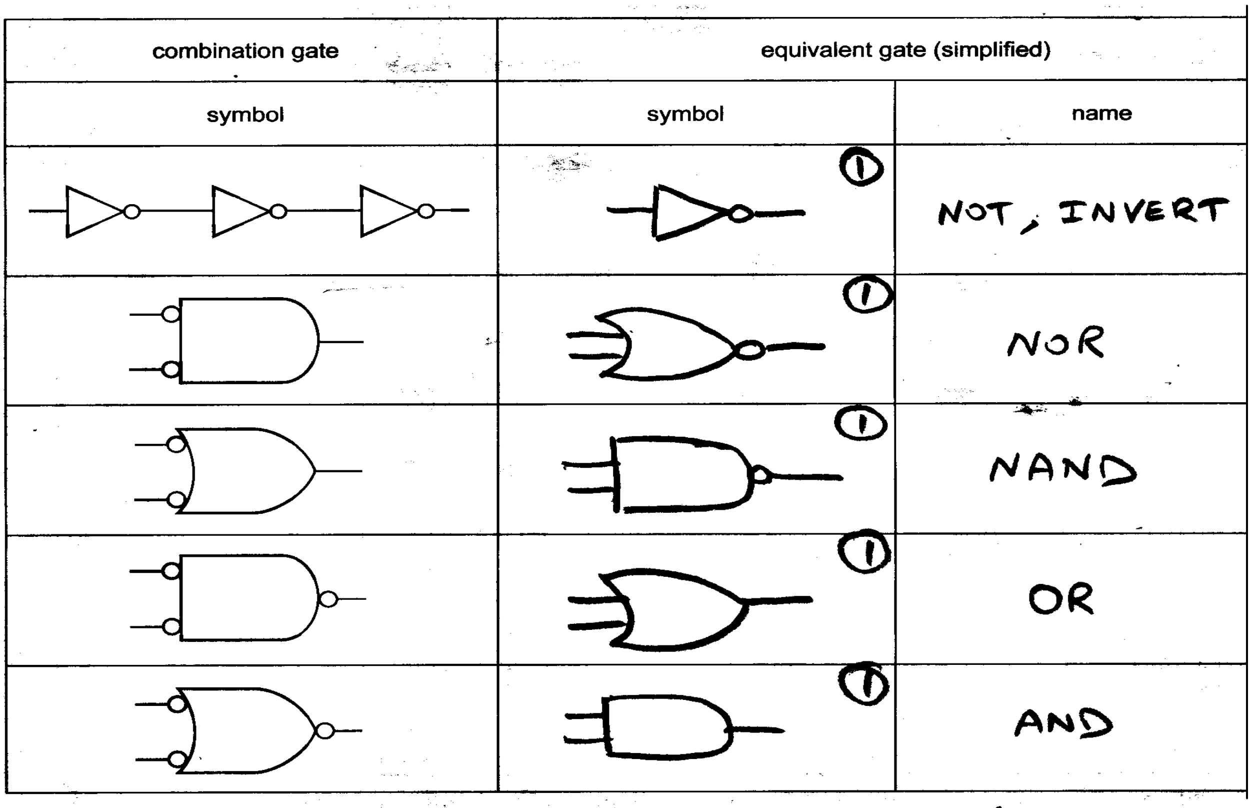
Remove pin 5 to pin 15.

iii.

Connect pin 8 to pin 15 (reset).

Question 2

Marks	0	1	2	3	4	5	6	7	8	9	10	Average
%	26	8	7	2	6	9	21	1	7	1	13	**4.2**



Most students were unable to convert the two input gates to the equivalent gate (simplified) version; however, students were still given partial marks if an incorrect gate symbol was drawn if it was correctly named. Each gate type could only be identified once.

It was apparent that many students had not been shown, or did not recall, the two-step simplification technique of converting to the opposite symbol by changing the gate symbol from 'and' to 'or' (or vice versa) and then adding or removing 'invert bubbles' to complete the conversion.

Question 3a

Marks	0	1	2	3	Average
%	18	8	14	59	**2.2**

gate number	gate type
gate 1	Not or Inverting gate
gate 2	Or gate
gate 3	And gate

Question 3bi.

Marks	0	1	2	Average
%	54	10	37	**0.9**

3bii.

Marks	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Average
%	12	0	0	2	3	5	4	4	6	2	3	8	2	6	42	**9.9**

Inputs			Outputs		
			Gate 1	Gate 2	Gate 3
C	B	A	Ā	Ā+B	(Ā+B).C = Q
0	0	0	1	1	0
0	0	1	0	0	0
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	1	1
1	0	1	0	0	0
1	1	0	1	1	1
1	1	1	0	1	1

Most students were able to gain some marks for this question, as Ā could usually be determined even if the other gate combinations could not be established.

Question 4a–b

Marks	0	1	2	3	4	Average
%	42	13	8	8	27	1.7

4a

decimal	binary	BCD
1234	10011010010	0001 0010 0011 0100

4b

hexadecimal	binary	decimal
ABC	101010111100	2748

Question 5a–b

Marks	0	1	2	3	4	5	Average
%	15	3	32	6	4	41	3.1

5a

ASCII HEX	45	6C	65	63	74	72	6F	6E	69	63
character	E	l	e	c	t	r	o	n	i	c

The conversion from 45 is a capital ‘E’, the rest are lower-case letters. If all upper-case or all lower-case letters were given, only one mark was awarded.

5b

ASCII HEX	45	6C	65
ASCII Binary 7 bit	100 0101	110 1100	110 0101

Question 6

Marks	0	1	2	3	Average
%	59	8	7	26	1.0

It is a converter – converts digital signals to analogue signals.

The Set Top Box is a digital signal receiver and decoder unit. It receives the digital signals transmitted from free-to-air digital TV stations. The unit decodes and converts the signals to conventional analogue TV modulated signals, which are fed into a standard analogue TV for viewing.

The critical factor that students were required to identify was that the Set Top Box performs a **digital to analogue conversion function**. Students who incorrectly identified the Set Top Box as a DVD player or VCR were not awarded any marks.

Question 7a–b

Marks	0	1	2	3	4	Average
%	40	4	2	18	35	**2.1**

7a
Low

7b

Inputs	Logic Level
A_2	L
A_1	H
A_0	L

'L' or '0' and 'H' or '1' were accepted.