Family Name: . . . . . **Other Names:** . . . . . .

ID Number: . . . . . **Signature** . . . . . .

ENGR 101: Test 2 Practice Questions

30 May, 2016

Instructions

- Time allowed: **50 minutes** .
- Answer **all** the questions. There are 50 marks in total.
- Write your answers in the boxes in this test paper and hand in all sheets.
- If you think some question is unclear, ask for clarification.
- This test contributes 20% of your final grade
- You may use paper translation dictionaries, and calculators without a full set of alphabet keys.
- You may write notes and working on this paper, but make sure your answers are clear.

Questions	**Marks**	
1. Boolean Algebra, Adders and Logic Gates	[]	
2. CPU Architecture	[]	
3. Software Quality and Testing	[]	
4. Professional Engineering	[]	
5. User Testing and the Scientific Method	[]	
6. Error signals, Control Systems and PID	[]	
7. Engineering Research Topic	[]	
	TOTAL:	

SPARE PAGE FOR EXTRA ANSWERS

Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

1. Boolean Algebra, Adders and Logic Gates **(12 marks)**

(a) **(4 marks)** For the boolean expression $Y = \bar{A}BC + A\bar{B}\bar{C} + \bar{A}\bar{B}C + AB\bar{C}$, draw a Karnaugh map and use it to simplify the expression for Y.

Y =

(b) **(3 marks)** Draw a logic circuit diagram for your answer to (a)

(c) **(5 marks)** State and show why you need both a half and a full adder to add a two 2 bit binary numbers together. Ensure to show both sum and carry bits and inputs and outputs for each adder.

Diagram:

2. CPU Architecture **(10 marks)**

(a) **(4 marks)** Explain the function of a multiplexer (MUX) in a logic circuit.

(b) **(4 marks)** The ALU has 5 control lines that between them instruct the ALU what to do. These are summarised in the table below:

K_4	K_3	K_2	K_1	K_0	**Function**
0	0	0	0	0	A OR B
1	0	1	0	0	NOT A
1	1	1	0	0	-A
0	1	1	0	0	B-A
X	X	X	0	1	A XOR B
X	X	X	1	0	A OR B
X	X	X	1	1	A AND B

What would the output be for the following machine code? Make sure you show how the machine code is interpreted, and the end result of the computation.
Note: The inputs A and B are in 4-bit binary and 2's complement notation.

11111 1001 0101

ALU Process:

Binary Output:

(c) **(4 marks)** What is RAM composed of? State any one difference between SRAM and DRAM.

3. Software Quality and Testing **(9 marks)**

You have been provided with a C method that takes two integers as inputs and attempts to the subtract the second from the first and return the output. Unfortunately the method does not work as expected. For example:

```
int subtracting(int a, int b){
        //the actual code that does the subtracting would go here
        return c;
}
```

(a) **(6 marks)** For the method above, list 2 test cases that could be test the functionality of the method. Explain what each test case tests, and the expected output should the method work correctly.

Test Case #1
Test Case #1 given input:

Test Case #1 expected output:

Test Case #1 explanation:

Test Case #2
Test Case #2 given input:

Test Case #2 expected output:

Test Case #2 explanation:

(b) **(2 marks)** When you call *subtracting(4,-2)*, the method returns 2. Insert a print statement you could add to the method to help you debug this issue in the code below.

```
int subtracting(int a, int b)\{



        \\subtracting calculation here



        return c;
}
```

(c) **(4 marks)** Compare print statements with proper debugging tools. Give one positive and one negative of each in your answer.

Reason #1:

Reason #2:

(d) **(2 marks)** After debugging you *subtracting* method, it passes all its unit tests. If the *subtracting* method is part of a larger program, are those unit tests sufficient to say there will not eb any bugs in the overall program because of your changes?

Explanation:

4. Professional Engineering **(24 marks)**

You run an e-commerce website for a small Australian company.

The website exhibits downtime according to the following table.

Down time (hours per year)	1	5	24	72
Probability of occurence	20%	15%	1.0%	0.025%

(a) **(2 marks)** Calculate the down time expected for a year. Make sure to show your working.

Yearly downtime:

(b) **(5 marks)** Identify and rank (from most important to least) the 5 aspects of software quality in terms of importance for this project.

Software Quality measures

#1 (Most important):

#2:

#3:

#4:

#5 (Least important):

5. User testing and the scientific method **(10 marks)**

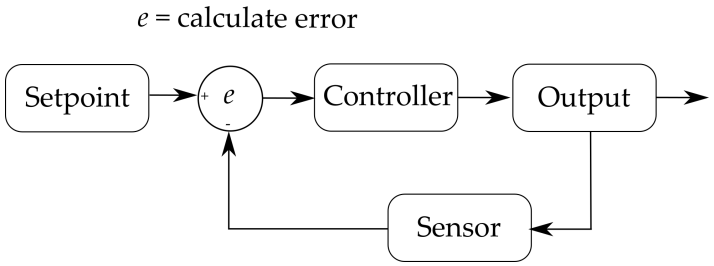
You are developing a new add-on for Google maps which enables people to rate specific locations based on time of day and time of year. You have decided to gather usage data by getting your classmates from ENGR101 to test the add-on for you by trying to rate a specific series of locations in Wellington as many times as possible during a day.

(a) **(4 marks)** State two potential sources of bias in the experiment you described above.

First Bias:

Second Bias:

6. Error signals, Control Systems and PID **(10 marks)**



(a) **(4 marks)** Describe two separate error signals that could be used as part of your AVC control system.

(b) **(4 marks)** Sketch a basic PID controller and explain how each component works.

7.
Engineering Research Topic **(12 marks)**

During the ENGR101 lectures you were provided with a series of readings and talks about research topics at the School of Engineering and Computer Science at Victoria University. Pick **ONE** of the following topics and give a concise introduction to it based on the content from one of these talks and readings. You must include at least some technical detail about the field and name a company that utilizes that form of Engineering or Computer Science as part of its business. You may include diagrams if they assist in your explanation.

- Machine Learning
- Self-driving vehicles
- Computer Graphics
- Fourier Transform in Sound
- Information Security
- Distributed Computing
- Mars Curiosity Rover

SPARE PAGE FOR EXTRA ANSWERS

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