

*Surname:*

*Other Names:*

*Student ID number:*

## **ENGR101 Engineering Technology**

**30<sup>th</sup> April 2015**

*Instructions:*

Total time allowed 45 minutes

There are 40 marks in total

Answer all questions

Write your answers on this sheet and take care to hand in all sheets. Additional paper is available should you need it.

**Show your working.**

This test contributes 15% of your final grade

Non-electronic translation dictionaries are permitted

Calculators are **not** permitted

### **Marking**

CORE (65%)	/ 26
COMPLETION (15%)	/ 6
CHALLENGE (20%)	/ 8
TOTAL:	/40

## **Core Section (for 65% of marks)**

### **Q1. Converting between binary and decimal representations.**

(i) Convert '10' from binary to decimal.

[2 marks]

2

(ii) Convert '1011' from binary to decimal.

[2 marks]

11

(iii) Convert '4' from decimal to binary.

[2 marks]

100

(iv) Convert '27' from decimal to binary.

[2 marks]

11011

**Question 2. Bytes & ASCII.**

(i) Describe in one sentence what a “byte” is.  
[2 marks]

*Answer: Sequence of 8 bits (binary digits)*

(ii) State what the maximum value of a variable of type “byte” is, and why.  
[2 marks]

*Answer: 255. Including 0 there are 256 possible levels/states.  
1 mark for the number, 1 mark for the reason. They can assume an unsigned byte.*

(iii) Describe in a couple of sentences the purpose of ASCII encoding.  
[2 marks]

*Answer: Only numbers can be processed and stored by computer. ASCII encoding is a correspondence between the character and the number.*

**Question 3: Communication.**

(i) Describe what an ADC is.  
[2 marks]

*Answer: Analog to Digital Converter to convert analog signals into digital stream.*

*Only one mark if all they do is expand the acronym.*

(ii) A clapper controlled LED is an example of sonic communication. Give an example of a situation where this may be useful.  
[2 marks]

*Answer:*

*Home automation uses.*

*Circuit isolation.*

*Smartphone apps using speakers.*

*[Any of the above - of logical explanations using sound waves to communicate - is acceptable. Only one example needed.]*

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**Question 4: Logic.**

(i) Write the truth table for a 1-bit comparator. This is a comparator that outputs 1 if both of the input bits are same.

[2 marks]

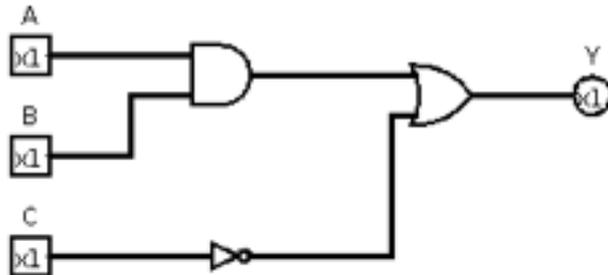
Bit 1	Bit 2	Output
0	0	1
0	1	0
1	0	0
1	1	1

*Answer: 1 mark for getting the first two columns correct (row order is not important here), and the other mark for getting the output column correct.*

(ii) Convert the following equation into a circuit:  $Y = AB + C'$

[2 marks]

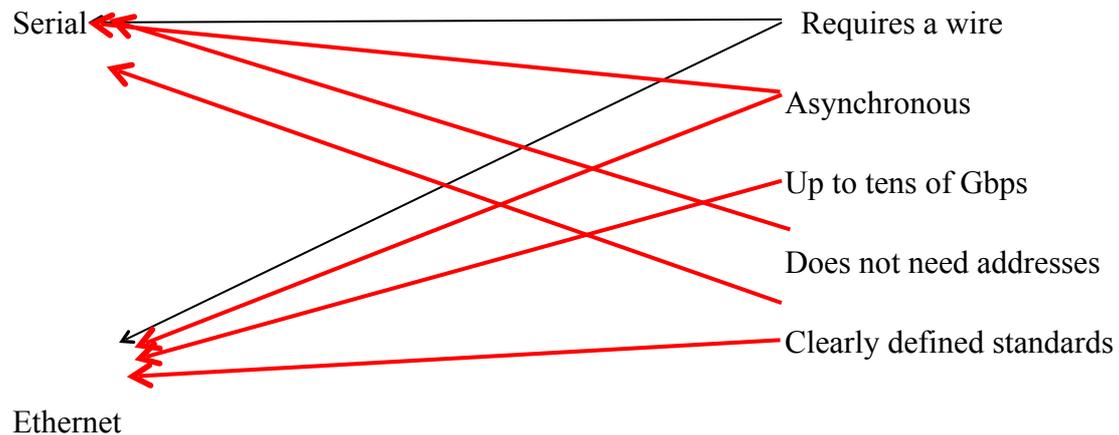
*Answer: Only 1 mark if they miss the C' and use C instead.*



**Question 5: Signals & Communication**

(i) Match the five communication characteristics in the right box to the most suitable mode of communication listed in the left box. Each characteristic may be matched to more than one mode of communication (one example is shown).

[2 marks]



*Answer: 1/3 of a mark for each of the six red lines that they needed to create. Round to the nearest half mark after final calculation.*

**Question 6: Arduino**

(i) What is wrong with the following Arduino code?

[2 marks]

```
// START OF CODE
void setup() {
  serial.begin(9600);
}
void loop() {
  a = 7;
  Serial.println(a);
}
// END OF CODE
```

*Answer: variable 'a' does not have a declared type, and all variables should have a type.*

## **Completion Section (for 15% of marks)**

### **Question 7: Signals and Communications**

(ii) What is the purpose of an input buffer?  
[2 marks]

*Answer: Purpose of input buffer is to store/accumulate slowly coming data so that processor can deal with bigger chunk of data at once.*

(ii) Discuss why data transmission rates for serial communication should be same for both transmitter and receiver.  
[2 marks]

*Answer: In serial communication channel duration of bit is fixed. It should be known to receiver so that received bits are decoded properly.*

### **Question 8: Logic**

(i) From the following truth table, derive a sum-of-products equation for the output.  
[2 marks]

A - input1	B – input 2	C – input 3	Y - output
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

*Answer:  $Y = B'C + A'B$*

*1 mark for each of the products.*

## Challenge Section (for 20% of marks)

### Question 9: Logic

- (i) For the logic table in Question 8(i), create the equivalent Karnaugh Map.  
[1 mark]

		B, C			
		00	01	11	10
A	0	0	1	1	1
	1	0	1	0	0

- (ii) Discuss why Karnaugh Maps are useful, and the reason that the columns are ordered in the manner that they are.  
[3 marks]

*Karnaugh Maps require that each column only differ by one bit, and they use human's pattern recognition ability to simplify boolean algebra expressions.*

**Question 10: Arduino**

- (i) State the values of 'x', 'y' and 'a[1]' after the following code has executed:  
[3 marks]

```
// CODE STARTS
int x;
int y;
int z;
int a[10];
for (x=0; x < 10; x++) {
    y = x;
}
// y = x + 1
for (z = 0; z < y; z++) {
    a[z] = x - z;
}
// CODE ENDS
```

x = \_\_\_\_\_ 10 \_\_\_\_\_

y = \_\_\_\_\_ 9 \_\_\_\_\_

a[1] = \_\_\_\_\_ 9 \_\_\_\_\_

- (ii) Would the code in (i) successfully complete if the “//” was removed from the start of the line: “y = x + 1;” (between the end of the first “for” loop and the start of the second “for” loop)? If yes, why? If not, why not?  
[1 mark]

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*Answer: it would fail as  $y = 11$ , and this would cause the second for loop to access an index into the array 'a' that was greater than the size of the array. Give students  $\frac{1}{2}$  a mark for pointing out there is a semi-colon missing from the line in the code (which is then fixed in the question itself).*