DUBLIN CITY UNIVERSITY

August 2000

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE
YEAR:	2
SEMESTER	2
EXAMINATION:	Electronics 2; PS206
EXAMINER:	Dr B. Lawless
DURATION:	2 hours
INSTRUCTIONS:	Answer 5 parts of Question 1 (50 %) and 2 other questions (25 % each)
	Hand up page 5 of this question book with your answer.
	Do not turn over this page until instructed to do so.

Question 1. Answer five parts of this question.

(a) Explain the operation of the NAND gate circuit shown in Figure 1.

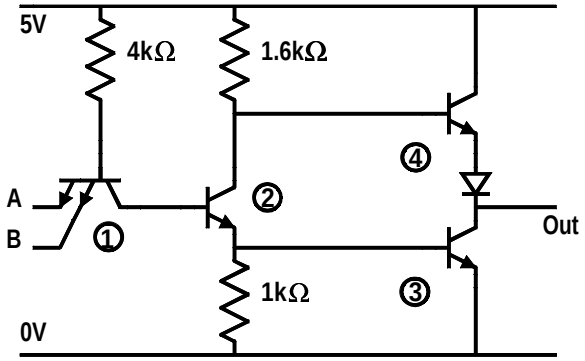

Figure 1: Question 1(a)

(b) Construct the truth table for the circuit shown in Figure 2.

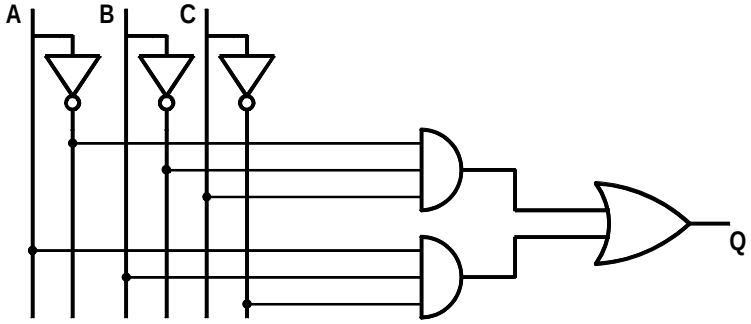

Figure 2: Question 1(b)

(c) i. Convert 3014_D to hexadecimal.
ii. Convert $2A9_H$ to decimal.
iii. Convert $E5_H$ to binary.

(d) Construct the truth table represented by

$$Q = f(A, B, C, D) = \Sigma m(1, 2, 6, 9, 14)$$

(e) Simplify the expression

$$Q = \overline{A}\overline{B}\overline{C}D + \overline{A}\overline{B}CD + A\overline{B}\overline{C}D + AB\overline{C}D + ABCD$$

(f) Explain what is meant by the term "Canonical Sum of Products form" as applied to a Boolean expression.

(g) Explain the principle of parity checking and show how it can be used to detect errors in digital systems.

(h) Explain the advantages of using Gray coding in angle and position sensors.

Question 2. (a) State de Morgan's Theorem.
Show how this theorem allows all logic functions to be implemented using either only NAND gates or only NOR gates.

(b) Write down the truth table for an XOR logic gate.
Show that the circuit shown in Figure 3 implements the XOR logic gate function.

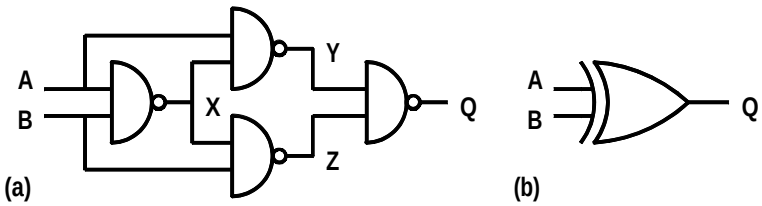

Figure 3: Question 2

Question 3. A particular logic application problem has been specified in the form of a minterm list given by:

$$Q = f(A, B, C, D, E) = \Sigma m(1, 4, 6, 9, 12, 14, 20, 25, 29)$$

Using this information you are to:

(a) Draw up the truth table for the system.

(b) Construct the Boolean expression for the system.

(c) Write down the Maxterm list for the system.

(d) Simplify the Boolean expression using any suitable method.

(e) Draw a circuit diagram which implements the circuit.

Question 4. (a) Explain how the ring of three inverters shown in Figure 4 acts as an oscillator circuit with a square waveform output.

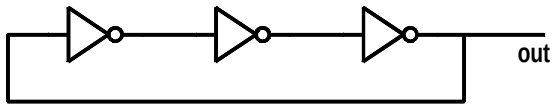

Figure 4: Question 4 (a)

(b) Explain the operation of a 555 Timer oscillator with reference to the internal circuit of the IC. Calculate the output, at pin 3, from the circuit shown in Figure 5 and give a scaled sketch of the waveforms at pins 2 and 3.

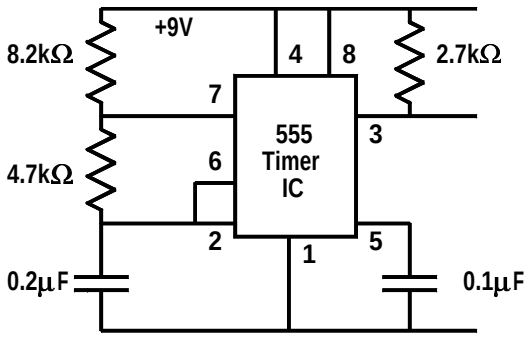

Figure 5: Question 4 (b)

Question 5. Discuss the operation of two of the following types of Analog to Digital converters, using flow charts and block diagrams where appropriate.

(a) Ramp type feedback converter.

(b) Successive approximation feedback converter

(c) Flash converter

(d) Integrating type converter.

Question 6. An RS flip flop can be constructed either from NAND gates or from NOR gates.
Give the logic gate diagram for each form of flip flop.
Explain the operation of the flip flops.
What are the differences in the truth tables for the two types of RS flip flop?
What extensions are necessary before an RS flip flop can be used to implement a counter circuit?