DUBLIN CITY UNIVERSITY

21 May 1998

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE
YEAR:	2
SEMESTER	1
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.

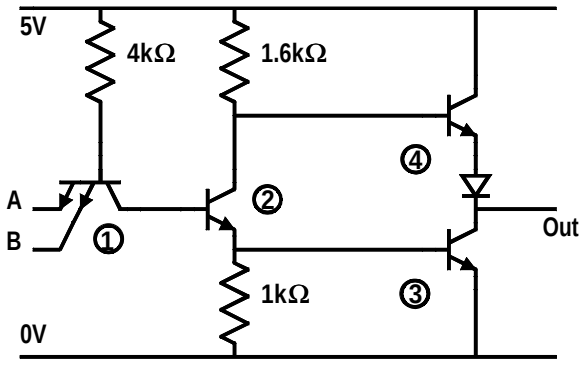

Figure 1: Question 1 (a)

(b) What are the conditions which determine whether a metal-semiconductor junction forms an ohmic or a rectifying junction?

(c) Give a brief description of CMOS technology and explain the advantages of using CMOS integrated circuits.

(d) Convert 1957_D to hexadecimal and convert $B971_H$ to decimal. Show all the details of the conversion steps in each case.

(e) What are the advantages of the Gray code numbering system?
Convert $1A3F_H$ to Gray code.

(f) Explain the advantages of error checking systems.
Give an account of two such error checking systems.
Explain the difference between error detection and error correction.

(g) State the postulates of Boolean Algebra.
Prove DeMorgan's theorem $\overline{A+B} = \overline{A}.\overline{B}$ and give a circuit equivalent of this version of the theorem.

(h) Construct the truth table for the circuit shown in Figure 2 and write down the Boolean expression for the circuit.

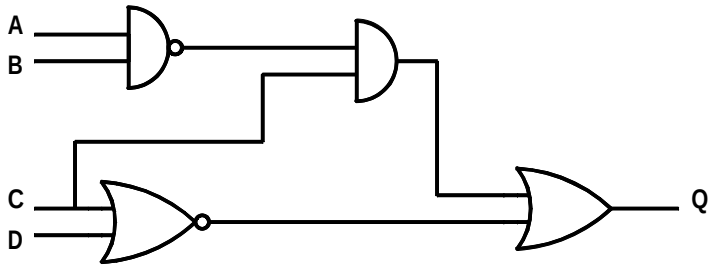

Figure 2: Question 1 (h)

Question 2. The truth table for a particular logic system, having a single output Q, is shown below.

(a) Derive the minterm and maxterm lists for the system.

(b) Draw the Karnaugh map for the system.

(c) Derive a Sum of Products Boolean expression for the system and draw the Sum of Products circuit (AND/OR).

(d) Derive a Product of Sums expression for the system and draw the Product of Sums circuit (OR/AND).

A	B	C	D	Q
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

Truth table for Question 2.

Question 3. Explain, with the aid of circuit diagrams, the operation of a JK flip flop.
What is meant by toggling action and how does it arise in the circuit?
How can JK flip flops be used to construct counters?
Explain how binary counters can be used to construct Mod(10) or base 10 counters?

Question 4. 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 5. (a) Explain how the ring of three inverters shown in Figure 3 acts as an oscillator circuit with a square waveform output.

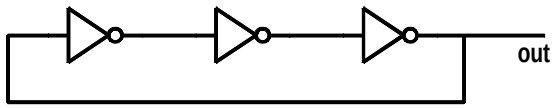

Figure 3: Question 4 (a)

(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 4 and give a scaled sketch of the waveforms at pins 2 and 3.

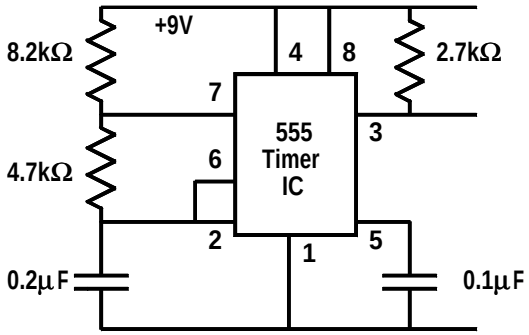

Figure 4: Question 4 (b)

Question 6. Use the table below to minimize the expression specified by the minterm list:

$f(A, B, C, D, E, F, G) = \Sigma m(14, 19, 23, 31, 38, 46, 51, 55, 59, 63, 75, 78, 81, 87, 99, 107)$

Verify your result by carrying out the minimization indicated by the table. You should return this page, with the table suitably marked, as part of your answer.

Write your name here .....

0	16	48	32	96	112	80	64
1	17	49	33	97	113	81	65
3	19	51	35	99	115	83	67
2	18	50	34	98	114	82	66
6	22	54	38	102	118	86	70
7	23	55	39	103	119	87	71
5	21	53	37	101	117	85	69
4	20	52	36	100	116	84	68
12	28	60	44	108	124	92	76
13	29	61	45	109	125	93	77
15	31	63	47	111	127	95	79
14	30	62	46	110	126	94	78
10	26	58	42	106	122	90	74
11	27	59	43	107	123	91	75
9	25	57	41	105	121	89	73
8	24	56	40	104	120	88	72

Table for Question 5