NATIONAL UNIVESITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH 2206 – DIGITAL ELECTRONICS

BSc HONOURS PART I: May 2006 *DURATION 3 HOURS*

ANSWER **ALL** PARTS OF QUESTION **ONE** IN SECTION **A** AND ANY **THREE** QUESTIONS FROM SECTION **B**. SECTION **A** CARRIES 40 MARKS AND SECTION **B** CARRIES 60 MARKS.

SHOW ALL YOUR STEPS CLEARLY IN ANY CALCULATION.

SECTION A

1. (a) Convert
   - (i) 63.7608_{10} to BCD [3]
   - (ii) 73241_{8} to Binary [3]
   - (iii) $7FA234_{16}$ to Binary [3]
   - (iv) $DC6.AF4_{16}$ to Binary [3]

   (b) Prove that
   $(A + B)\overline{AB} = A\overline{B} + \overline{A}B$ [2]

   (c) Give the difference between asynchronous and synchronous counters? [3]

   (d) Verify that
   - (i) $(A+B)\bullet(\overline{A}+\overline{B}+C) = A\bullet C + \overline{B}$ Using Boolean algebra [3]
   - (ii) $A \oplus C = A\bullet\overline{C} + \overline{A}\bullet C$ Using truth table [3]

   (e) Convert
   - (i) 10110011.110011_2 to hexadecimal and octal form [6]
   - (ii) 0.0000011101_2 to hexadecimal and octal form [6]

   (f) Discuss the difference between sequential and combinational logic [2]

   (g) Explain the following terms:
   - (i) Logic threshold
   - (ii) Noise Margins
   - (iii) Propagation Delay [3]

SECTION B.

2. (a) Write the logic function for the truth table shown. [4]

A	B	C	G
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

(b) Simplify the function to the simplest sum of products form, showing the algebraic law or identity used for each step. [6]

(c) Define each of the following conditions
(i) astable,
(ii) Bistable and
(iii) Monostable. [6]

(d) Simplify the following function and draw a logic circuit diagram for the original and simplified circuit

$$R = \overline{A}BC + AB\left(C + \overline{C}\right) + A\overline{BC}$$ [4]

3. (a) Draw a logic diagram for the RS flip-flop using:
(i) NOR gates [2]
(ii) NAND gates [2]

(b) Distinguish between a
(i) parallel and serial register [4]
(ii) buffer register and jam entry [4]

(c) Develop the control logic for an electronic door lock that will open the lock only when the correct one of the 32 combinations is selected. If the incorrect combination is tried an alarm will sound [8]

4. (a) Use the K-Map to simplify the following Boolean expressions.

(i) $F(ABC) = \overline{A}B\overline{C} + \overline{A}BC + AB\overline{C} + ABC$ [4]

(ii) $X = \overline{A}(BC + B\overline{C}) + A(BC + B\overline{C})$ [4]

(b) State and prove De Morgan's theorems. Use the theorems to minimize the following functions.

(i) $\overline{\overline{A + B + \overline{C}} + D(\overline{E + \overline{F}})}$

(ii) $\overline{(A + \overline{B})(\overline{C} + D)}$ [10]

(c) What is encoding? [2]

5. (a) Convert the following expressions into canonical form:

(i) $(A + B)(B + C)$ [3]

(ii) $(A + A\overline{B})$ [3]

(b) Define each of the following:

(i) commutative property, [2]

(ii) associative property, [2]

(iii) distributive property. [2]

(c) Draw a minimum configuration logic diagram to represent the statement

(i) $F = ABC + \overline{B} + C$ [4]

(ii) $F = \overline{\overline{A}B + A\overline{C}} + \overline{B}\overline{C}$ [4]

6. (a) What is a Schmitt trigger? [3]

(b) Suggest one application of a Schmitt trigger [2]

(c) Draw a logic diagram and timing diagram that show how a Schmitt trigger can be used to square up pulses. [5]

(d) Design an EXNOR Gate using:
(i) only NAND gates,
(ii) only NOR Gates. [10]

- END OF EXAMINATION -