NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH 2106 – DIGITAL ELECTRONICS

BSc HONOURS PART II: JANUARY 2004 DURATION: 3 HOURS
(RADIOGRAPHY)

ANSWER **ALL** PARTS OF QUESTION 1 IN SECTION **A** AND ANY **THREE** QUESTIONS FROM SECTION **B**. SECTION **A** CARRIES 40 MARKS WHILE SECTION **B** CARRIES 60 MARKS. DRAW NEAT DIAGRAMS WHEREVER NECESSARY.

Speed of light	$c = 3.00 \times 10^{8}$ ms^{-1}
Charge on an electron	$e = 1.60 \times 10^{-19}$ C
Permittivity of free space	$\varepsilon_o = 8.85 \times 10^{-12} Fm^{-1}$
Permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ Hm^{-1}

SECTION A

1. (a) Determine 2's complement of each of the following binary numbers

(i) 1101_2, (ii) 11100_2, (iii) 10011_2 and (iv) 10110111_2 [4]

(b) Perform the following operation using *BCD* addition.
(i) 00100101 + 00100111 (ii) 01010001 + 01011000
(iii) 11110 + 11011 + 11101 and (iv) 10111 + 1011 [4]

(c) Decode the following ASCII coded message.
1000001101001110010001001111100101l. [4]

(d) Write the name *JESUS* in ASCII and EBCDIC code. [6]

(e) Use K-map to simplify the following Boolean expressions:

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

(ii) $F(A,B,C,D) = \sum m(4.5.7.12,1415) + \sum d(3,8,10)$

[8]

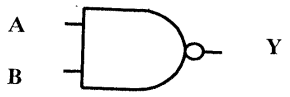
(f) State and prove De Morgan's theorem. Use the theorem to simplify the following functions:

(i) $\overline{\overline{(A.B)}.A} \quad \overline{\overline{(A.B)}.B}$

(ii) $\overline{A.B} + \overline{\overline{A} + B}$

[8]

(g) How will you realize the following logic using DTL? Give truth table and explain its operation.



[6]

SECTION B

2. (a) Show that the "NAND" and "NOR" gates are universal gates. [7]

(b) A circuit is required to monitor an automobile safety belt system. An audio signal should be produced to warn a driver that a seat belt is not engaged, when the ignition switch is " ON". The alarm should last for specified time and then turn "*off*" automatically. Draw a circuit diagram for this system. Give the truth table. [7]

(c) A certain gate draws a current of 2 mA when its output is "HIGH" and 3.5 mA when its output is "LOW". What is the average power dissipation if V_{CC} is 5V and is operated on 50 % duty cycle? [6]

3. (a) What is the difference between half-adder and full adder [4]

(b) Design a " *Half Adder* " using minimum number of "*Nand*" gates only. [8]

(c) Describe the methods of speeding addition. [8]

4. (a) Draw a state and timing diagrams for a BCD decade counter. Explain the operation of a *synchronous* BCD decade counter. [10]

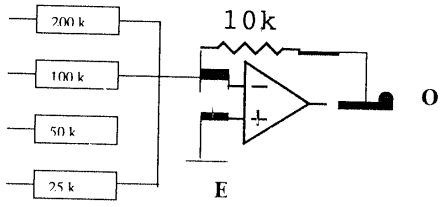
(b) Draw a ten stage ring counter and show the table of its sequence. [5]

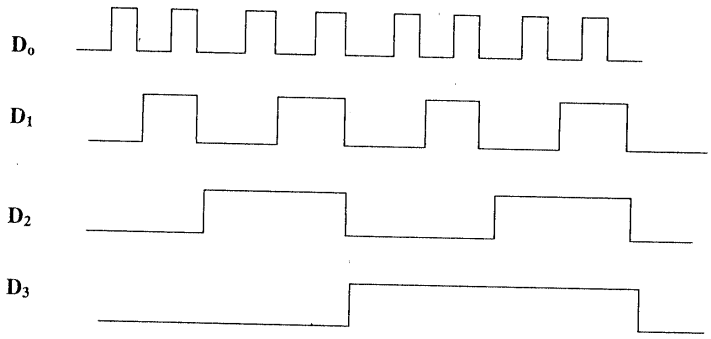
(c) If the ten stage ring counter has the initial stage 1010000000, determine the waveform of the Q outputs. [5]

5. (a) Give the performance characteristics of a D/A Converter. [4]

(b) Draw the circuit diagram of a "Four Bit Binary Weighted input D/A converter. Explain its operation. [8]

(c) Determine the output of the D/A converter shown below for the sequence of four bit numbers that are applied to the inputs. D_o is the LSB. [8]





6. (a) Draw a neat diagram of a "*successive approximation*" A/D converter and explain its operation. [10]

(b) Explain the terms:

(i) Resolution, (ii) Sampling Rate and (iii) UART [6]

(c) Determine the resolution for each of the following D /A converters.
(i) Four bit, (ii) six bit and (iii) 18 bit. [4]

END OF PAPER