

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

DIGITAL ELECTRONICS SPH 2206

SUPPLEMENTARY EXAMINATION

BSC. (HONS) PART IV

AUGUST 2004

DURATION: 3 HOURS

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.

Planck's Constant	$h = 6.63 \times 10^{-34} \text{ Js}$
Boltzmann's Constant	$k = 1.38 \times 10^{-23} \text{ JK}^{-1}$
Speed of light	$c = 3.00 \times 10^8 \text{ ms}^{-1}$
Charge on an electron	$e = 1.60 \times 10^{-19} \text{ C}$
Mass of an electron	$m_e = 9.10 \times 10^{-31} \text{ kg}$
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$

SECTION A

- 1 (a) Perform the following operations using 1's and 2s-complement method. [6]
- (i)  $111111 - 11011$ , (ii)  $111001 - 10110$ , (iii)  $1011111 - 11011111$
- (b) Find the value of the following binary operations: [4]
- (i)  $110111 \div 1011$ , (ii)  $11101 * 1110$  (iii)  $11110 + 11011 + 11101$  and (iv)  $10111 - 1011$
- (c) Write the following numbers in 8421 and 2421 coding systems: [4]
- (i)  $1475_{10}$  and (ii)  $555_8$
- (d) Perform the following operation using BCD addition. [4]
- (i)  $10100101 + 01100111$  (ii)  $11010001 + 11011000$   
(iii)  $11110 + 11011 + 11101$  and (iv)  $10111 + 1011$
- (d) Use K-map to simplify the following Boolean expressions: [4]
- (i)  $F(ABC) = \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}\bar{C} + ABC$   
(ii)  $X = \bar{A}(BC + B\bar{C}) + A(BC + B\bar{C})$
- (e) State and prove De Morgan's theorem. Use the theorem to minimize following functions:
- (i)  $(A+B)(\bar{A}+C)(B+C) = (A+B)(\bar{A}+C)$

(ii)  $A+BC = (A+C)(A+B)$

[8]

- (f) Draw the diagrams for the four input multiplexers and four output demultiplexers. Give one application of each of them.

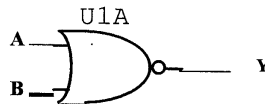
[6]

- (g) Explain the terms: (i) Logic threshold, (ii) Noise Margin and (iii) Propagation Delay.

[4]

### SECTION B

- 2 (a) How will you realize the following logic using DTL? Give the truth table for its operation.



[6]

- (b) A gate is required to monitor two lines, to detect the occurrence of "LOW" level voltages on either or both lines, and to generate a "HIGH" level output used to illuminate an indicator lamp. Draw the circuit and explain the operation.

[8]

- (c) A certain gate draws a current of 4 mA when its output is "HIGH" and 5.5 mA when its output is "LOW". What is the average power dissipation if  $V_{CC}$  is 5V and is operated on 60 % duty cycle?

[6]

- 3 (a) What is the difference between a flip-flop and a register?

[4]

- (b) Determine the method for implementing full-adder.

[8]

- (c) Describe the operation of carry look ahead adder. What is the advantage of this method?

[8]

- 4 (a) Draw a diagram for the four stage Johnson Counter. Give the truth table and explain the operation of the counter.

[8]

- (b) Draw a ten stage ring counter and show table of its sequence.

[5]

- (c) If the ten stage ring counter has the initial stage 101000000, determine the waveform of the Q outputs.

[7]

- 5 (a) Give the performance characteristics of D/A Converter.

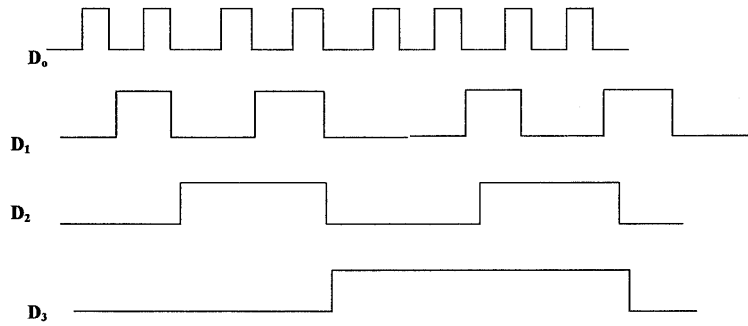
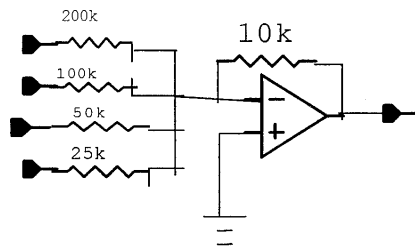
[4]

- (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.  $D_0$  is the LSB. You may take input voltage as 5V.

[8]



6 (a) Draw a neat diagram of a "Dual Slope 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) Five bit, (ii) seven bit and (iii) 16 bit.

[4]

**END OF PAPER**