Name		**Quiz Date**	2020.02.31
Student #		**Time**	110min
Mark		**Full Mark**	30pt

04.03.20 08:07

Please remember to write your name and student number. Calculators are not allowed. The consequences of cheating will be severe (death by Darth Vader force choke).

Midterm

1. (5pt) Multiple choice questions

   I. Which of the following is NOT mentioned in the von Neumann architecture?

      A. I/O devices

      B. CPU

      C. GPU

      D. Memory

   II. What is the purpose of Embedded systems (comparing to von Neumann machines)?

      A. Help the CPU perform specific tasks

      B. Provide simpler circuit design solutions to simpler tasks

      C. More efficient at specific tasks than von Neumann machines

      D. All of above

   III. What is the difference between 1-bit full-adder versus 1-bit half-adder?

      A. Has additional carry bit input

      B. Has additional carry bit output

      C. Has longer gating delay

      D. Has shorter gating delay

   IV. What is the purpose of buffer gates?

      A. Reduce gating delays

      B. Reinforce signal strength

      C. Store information

      D. Sell products at a higher price on eBay

   V. Which of the following functional blocks is used to select input from various sources?

      A. Encoder

      B. Decoder

      C. Multiplexer

      D. Enabler

2. (5pt) Representations of numbers: 42, 71

   A. Write down the values in Binary, Octal, and Hexadecimal systems

   B. Represent the values as 8-bit unsigned integers, with the first bit for odd parity

   C. Represent the values in BCD

   D. Represent the values as 8-bit signed integers, also write down their SIGNED 2s complements

   E. Represent the NEGATIVE values of these numbers in 8-bit signed, also write down their SIGNED 2s complements

3. (5pt) Boolean algebra

   A. Prove using truth table: $\overline{X}Y + \overline{Y}Z + X\overline{Z} = X\overline{Y} + Y\overline{Z} + \overline{X}Z$

   B. Prove using algebraic manipulation: $X + \overline{\overline{Y} + \overline{Z}} = (X + Y)(X + Z)$

   C. Simplify using algebraic manipulation:
   $(A + B + C + D)(A + B + C + \overline{D})(A + B + \overline{C})(A + \overline{B})$

   D. Simplify using K-map: $F(A, B, C, D) = \Sigma m(2,3,8,9,10,12,13,14)$

   E. Simplify using K-map with don't care conditions: $F(A, B, C) = \Sigma m(2,3,5,6)$, $d(A, B, C) = \Sigma m(4,7)$

4. (5pt) Design a circuit to implement the following pair of Boolean equations:

$$F = A(C\overline{E} + DE) + \overline{A}D$$
$$G = B(C\overline{E} + DE) + \overline{B}C$$

To simplify drawing the schematic, the circuit is to use a hierarchy based on the factoring shown in the equation. Three instances (copies) of a single hierarchical circuit component made up of two AND gates, an OR gate, and an inverter are to be used. Draw the logic diagram for the hierarchical component and for the overall circuit diagram using a symbol for the hierarchical component.

5. (5pt) Design a 16-to-1 multiplexer using 4-to-16 decoder and a 16 2-input AND gate and a 16-input OR gate.

6. (5pt) Implement binary subtractor

   A. Implement a 1-bit binary subtractor (1.5pt)

   B. Implement a 4-bit binary subtractor (1.5pt)

   C. When will the results from this subtractor be incorrect? Briefly describe using equations how corrections might be done. (2pt)