

ShanghaiTech University

EE 115B: Digital Circuits

Fall 2024

Midterm Exam, November 14, 2024

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Student ID: _____ Name in Chinese: _____

1. Short questions. (10 points, 1 point each.)

(1) Convert $(26.5)_{10}$ to binary.

(2) Convert $(10101.01)_2$ to decimal.

(3) Convert $(24.8)_{16}$ to octal.

(4) Convert $(32)_8$ to BCD.

(5) Convert $(01010011)_{\text{BCD}}$ to hexadecimal.

(6) Determine the odd parity bit for 100110101.

(7) (True or False.) The XOR gate is also called the equivalence gate.

(8) What does “VHDL” stand for?

(9) What does “FPGA” stand for?

(10) Given the following VHDL code, write the logic function for F.
 $F \leq A \text{ or } B \text{ and } C \text{ or } D;$

$F =$ _____

2. Develop the minimum SOP and POS expressions with and without the don't cares using Karnaugh map. (20 points, 5 points each.) NOTE: In this exam, SOP means sum of products and POS means product of sums.

$$Y(A, B, C, D) = \sum m(3, 5, 6, 8, 11, 13, 15) + D(0, 7, 10)$$

3. Develop the minimum POS expression (NOTE: NOT the minimum SOP expression) for the following function using the Quine-McCluskey method. (20 points.)

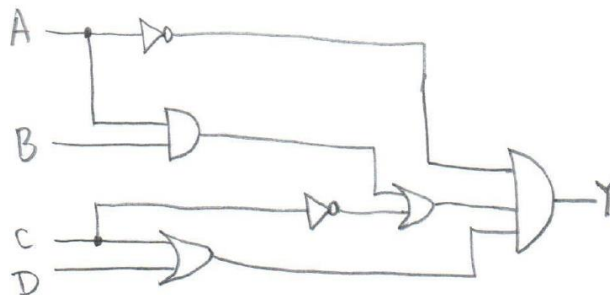
$$Y(A, B, C, D) = \sum m(2, 3, 4, 6, 8, 10, 11, 14, 15)$$

This page is reserved for Problem 3.

4. Convert the following AND-OR expression to NAND, AND-OR-Invert (AOI), and NOR expressions. (15 points, 5 points each.)

$$Y(A, B, C, D) = A'C' + B'D' + BD$$

5. Convert the following circuit to NAND-only and NOR-only circuits. You need to use the standard NAND and NOR symbols to draw your final circuits. (20 points, 10 points each.)



This page is reserved for Problem 5.

6. Design a circuit with three inputs and one output. The output is 1 if an odd number of inputs is(are) 1. You need to: (a) define the logic variables and build the truth table, (b) develop the minimum SOP expression for the output, and (c) draw the circuit diagram using AND, OR, and NOT gates based on the minimum SOP expression. (15 points, 5 points each.)

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Do NOT use this page as an answer sheet.**