

King Fahd University of Petroleum and Minerals
College of Computer Science and Engineering
Computer Engineering Department

COE 202: Digital Logic Design (3-0-3)
Term 141 (Fall 2014-2015)
Major Exam 1
Saturday October 18, 2014

Time: 90 minutes, Total Pages: 8

Name: _____ ID: _____ Section: _____

Notes:

- Do not open the exam book until instructed
- **No Calculators are allowed** (*basic, advanced, cell phones, etc.*)
- Answer all questions
- All steps must be shown
- Any assumptions made must be clearly stated

Question	Maximum Points	Your Points
1	17	
2	16	
3	12	
4	15	
Total	60	

Question 1.**(17 points)**

(I) Without converting to decimal, express the binary number $(111.0101)_2$ in **Octal** and **Hexadecimal**. **(4 points)**

(II) Express the decimal number 129.33 in **Binary** and **BCD** (with 4-bit fraction accuracy).

(6 points)

(III) Adding an **even parity** bit as the MSB, the Binary code 1001101 becomes _____

(1 point)

(IV) Perform the following arithmetic operations in the given bases. (Show your work) **(6 points)**

Binary Multiplication	Binary Subtraction	Hexadecimal Addition
$\begin{array}{r} 1011 \\ \times \underline{101} \end{array}$	$\begin{array}{r} 100.10 \\ - \underline{11.01} \end{array}$	$\begin{array}{r} 37A \\ + \underline{93} \end{array}$

Question 2.**(16 points)**

Use Boolean algebra to solve the following questions. Show clearly all your steps.

(I) Simplify each the following Boolean functions to the specified number of literals:

a. $F1 = x y z + \bar{x} y + \bar{x} \bar{y}$ **(3 literals)**

(3 points)

b. $F2 = \bar{x} \bar{y} \bar{z} + \bar{x} y \bar{z} + \bar{x} y z + x \bar{y} \bar{z}$ **(4 literals)**

(4 points)

c. $F3 = w x + w x y + \bar{w} y z + \bar{w} \bar{y} z + \bar{w} x y \bar{z}$ **(6 literals)**

(5 points)

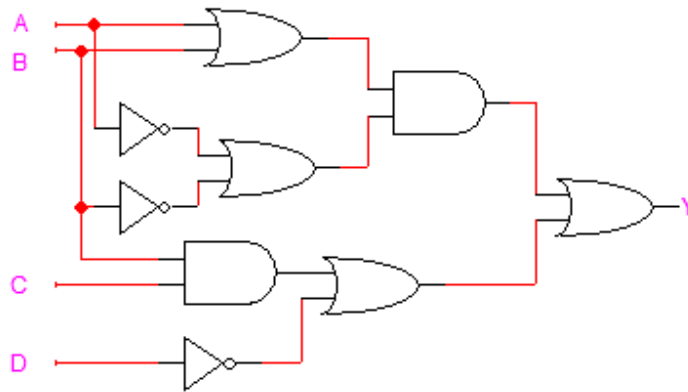
(II) **Without simplification**, write out the **complement** and **dual** forms of the following expression:

$$(x + \bar{y} \bar{z})(w \bar{x} z + \bar{w} y \bar{z})$$

(4 points)

Question 3.**(12 points)**

(I) Express the Boolean function Y of the following given circuit without simplification:

(3 points)(II) Given the Boolean function $F(X, Y, Z) = (X + Y)(\bar{X} + Z)(\bar{Y} + \bar{Z})$:**(6 points)**a. Express F as a **product-of-maxterms**, $F = \prod M$.b. Find the **algebraic sum-of-minterms** expression for F.

(III) Given that $F(A, B, C) = \sum m(0, 2, 5, 6)$ and $G(A, B, C) = \prod M(1, 2, 5, 7)$, express the function $F \cdot \bar{G}$ as a **sum-of-minterms**. **(3 points)**

Question 4.

(15 points)

(I) Circle the correct word in the following statements: **(3 points)**

- a. It is desirable to have a low noise margin NM_L as (large - small) as possible
- b. It is desirable to have a high noise margin NM_H as (large - small) as possible
- c. It is desirable to have V_{IH} as (large - small) as possible
- d. It is desirable to have V_{IL} as (large - small) as possible
- e. It is desirable to have V_{OH} as (large - small) as possible
- f. It is desirable to have V_{OL} as (large - small) as possible

(II) Fill in the Truth Table for each of the following three circuits. Indicate whether the circuit operates properly or not. If circuit operation is improper (invalid) state the reason for that. Inputs A, and B are independent of one another and may assume any possible binary values.

(6 points)

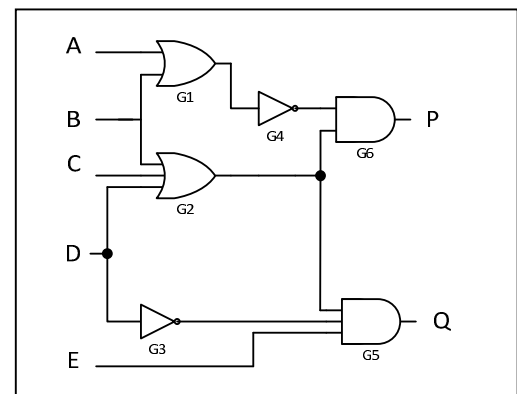
Circuit	Truth table of the given circuit	If a circuit operation is invalid, state why.															
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(III) The shown table gives propagation delays of some basic gates. For the circuit shown below, answer the following:

- a. Identify the critical path of the circuit (path with longest propagation delay). What is its associated delay value?

(3 points)

Gate	Delay
Inverter	1 ns
2-Input AND	2 ns
2-Input OR	3 ns
3-Input AND	3 ns
3-Input OR	4 ns



- b. What is the maximum frequency at which the circuit may be operated?

(1 point)

- c. The gate which drives the largest load is gate _____

(1 point)

- d. Name *a gate* that has the highest fanin in the circuit (_____), the fanin of this gate is _____

(1 point)