***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 142 (Spring 2014-2015)**

**Major Exam 1**

**Saturday February 28, 2015**

**Time: 90 minutes, Total Pages: 7**

**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** | **25** |  |
| **2** | **20** |  |
| **3** | **10** |  |
| **Total** | **55** |  |

**Question 1. (25 points)**

1. Convert the following numbers from the given base to the other uncrossed bases listed in the table (if needed, express fractions up to 3 digits only). **(12 points)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Decimal** | **Binary** | **Octal** | **HEX** | **EXCESS-3 BCD** |
| **109.39** |  |  |  |  |
|  | **10101101.101** |  |  |  |
|  |  |  | **E7.48** |  |

1. Perform the following arithmetic operations in the specified number system. **(8 points)**

|  |  |  |  |
| --- | --- | --- | --- |
| Octal Subtraction  4 5 1 2   * 2 5 3 7   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Hexadecimal Addition  F E A 3  + A F 9 D  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Binary Subtraction  1 1 1 0 0 0 1 0  - 1 0 1 1 1 1 1 1  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Binary Addition  11011011  +01110111  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. Two number system with radixes *and* *,* have the following two relations:
   1. , *and*

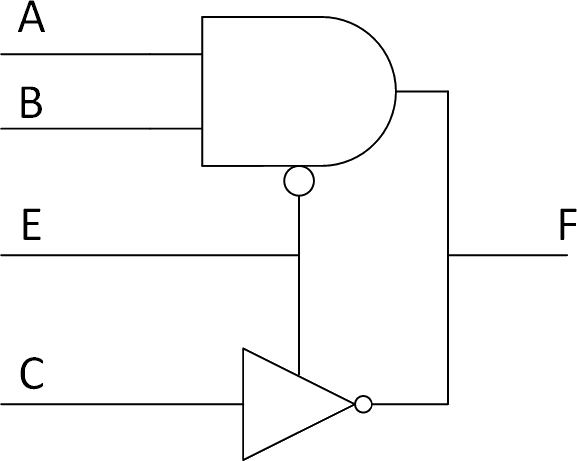
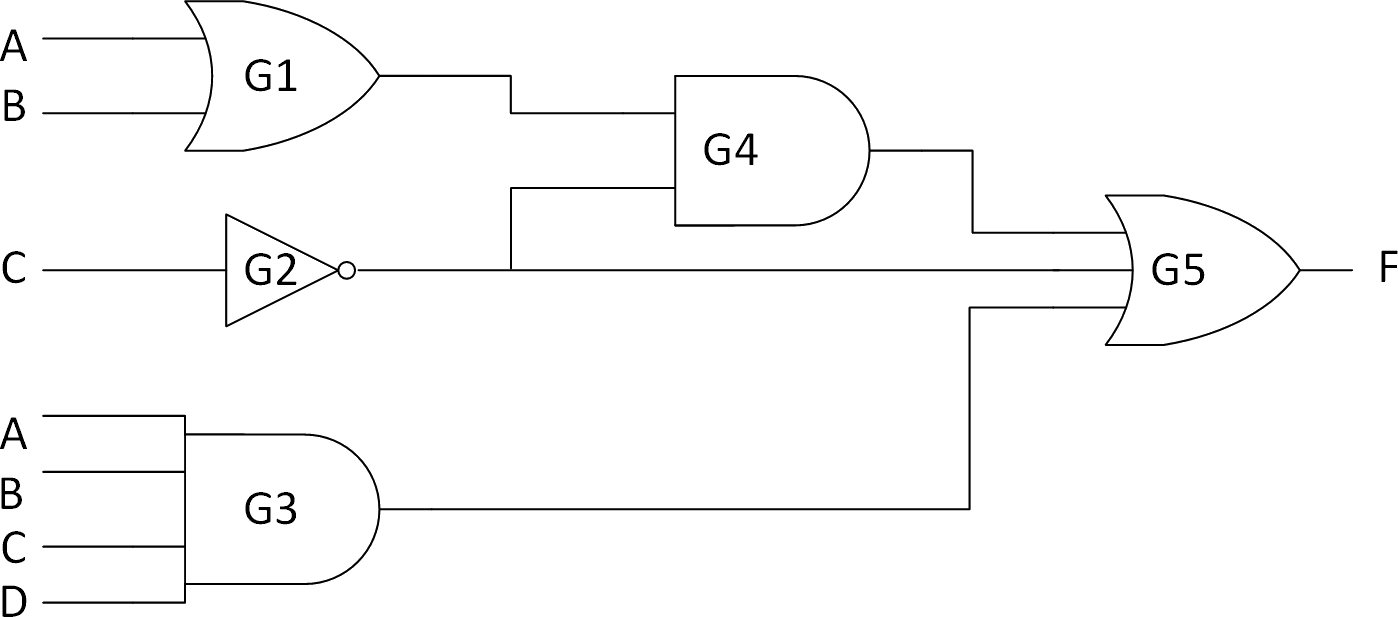
What are the values of *and* ? **(5 points)**

**Question 2. (20 points)**

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

|  |
| --- |
| 1. Simplify each of the following Boolean functions to the specified number of literals in sum-of-products (SOP) representation: 2. **(2 literals) (1 point)** 3. **(3 literals) (4 points)** 4. **(1 literal) (4 points)** 5. **(3 literals) (4 points)** |
| 1. Given the Boolean function : **(5 points)** 2. Express F as a **product-of-maxterms**, . 3. Find the ***algebraic* sum-of-minterms** expression for *F*.      1. Given the following Boolean function expressed using sum-of-products representation. , express F as a product-of-sums (NOT as product-of-maxterms) representation. **(2 points)** |
|  |

**Question 3. (10 points)**

1. Without simplification, write the Boolean algebra equation that represents F: **(2 points)**
3. Fill the table based on the Logic diagram **(3 points)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Gate** | **Delay (*ns*)** | **Fanin** | **Driving Load** |
| G1 | 2 |  |  |
| G2 | 1 |  |  |
| G3 | 3 |  |  |
| G4 | 2 |  |  |
| G5 | 2 |  |  |

1. What is the worst-case delay? **(1 point)**
2. What is the worst-case delay path? **(1 point)**
   1. You are required to mark the *VIL, VIH, VOL, VOH* parameters on the following diagram given that the values of these parameters are *selected* from the set **{0.5*v*, 1.0*v*, 3.5*v*, 4.2*v*}**\***.** **(2 points)**

\*(*Voltage values are given in ascending order, i.e. not necessarily in the same order of the VIL, VIH, VOL, VOH parameters*)

|  |  |  |
| --- | --- | --- |
| **Input voltages** |  | **Output voltages** |
|  |  |  |
|  | *4v* |  |
|  |  |  |
|  | *3v* |  |
|  |  |  |
|  | *2v* |  |
|  |  |  |
|  | *1v* |  |
|  |  |  |
|  | *0v* |  |

* 1. Calculate the Noise Margin for logic 1 (NM1)? **(1 point)**

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