***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:\_KEY\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 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** | **1101101.011** | **155.307** |  | **0100 0011 1100. 0110 1100** |
| **173.625** | **10101101.101** |  | **AD.A** |  |
| **231.281** |  | **347.22** | **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   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  1 7 5 3 | Hexadecimal Addition  F E A 3  + A F 9 D  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  1 A E 4 0 | Binary Subtraction  1 1 1 0 0 0 1 0  - 1 0 1 1 1 1 1 1  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  0 0 1 0 0 0 1 1 | Binary Addition  11011011  +01110111  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  101010010 |

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

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

**Solution**

1. 🡪 substituting in (a)

🡪 🡪 **2 Solutions**

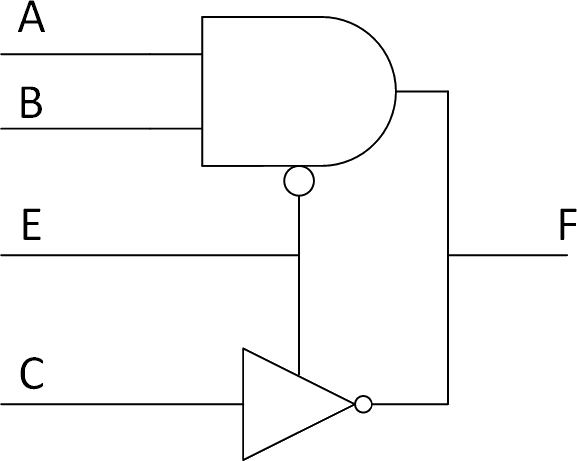
1. 🡪 🡪 Infeasible solution
2. 🡪 🡪 Correct solution

**Question 2. (20 points)**

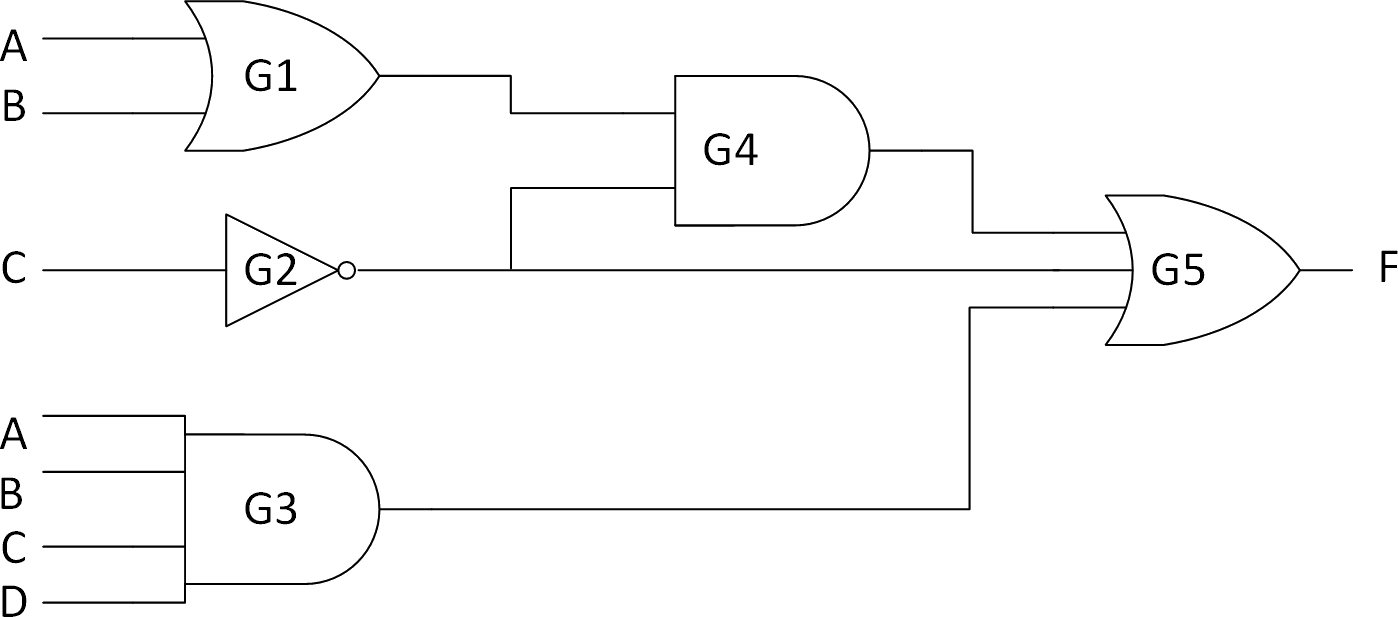
Use Boolean algebra to solve the following questions. Show clearly all your steps.

|  |
| --- |
| 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)**      1. **(3 literals) (4 points)** 2. **(1 literal) (4 points)** 3. **(3 literals) (4 points)** |
| 1. Given the Boolean function : **(5 points)** 2. Express F as a **product-of-maxterms**, .      1. 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)**   (by Demonrgan\s law)  (by distributive law)  (by consensus) |
|  |

**Question 3. (10 points)**

1. Without simplification, write the Boolean algebra equation that represents F: **(2 points)**

F = EC’+ E’AB

2. Fill the table based on the Logic diagram **(3 points)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Gate** | **Delay (*ns*)** | **Fanin** | **Driving Load** |
| G1 | 2 |  | 1 |
| G2 | 1 |  | 2 |
| G3 | 3 | 4 |  |
| G4 | 2 | 2 | 1 |
| G5 | 2 | 3 |  |

1. What is the worst-case delay? **(1 point)**

2+2+2=6ns

1. What is the worst-case delay path? **(1 point)**

G1, G4, G5

* 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* |  | *VOH=4.2v* |
|  | *VIH=3.5v* |  |  |
|  | *3v* |  |  |
|  |  |  |  |
|  | *2v* |  |  |
|  |  |  |  |
|  | *VIL=1.0v* |  |  |
|  |  |  | *VOL=0.5v* |
|  | *0v* |  |  |

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

NM1= *VOH – VIH* = 4.2 – 3.5 = 0.7 v