***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 162 (Winter 2016)**

**Major Exam 1**

**Saturday, March 11th, 2017**

**Time: 90 minutes, Total Pages: 6**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ID:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Section: \_\_\_\_\_\_\_**

**Notes:**

Do not open the exam book until instructed

**Calculators are not 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** | **12** |  |
| **2** | **17** |  |
| **3** | **19** |  |
| **Total** | **48** |  |

**Question 1: Fill in the Spaces: (Show all work needed to obtain your answer) [14 marks]**

1. The decimal number 15 is represented in **BCD** as **\_\_\_\_\_\_\_\_\_** (Fill in the space). **(1 Point)**
2. Given $F(A,B,C)=\sum\_{}^{}m\left(0,3,5,7\right)$ and $ G\left(A,B,C\right)=\prod\_{}^{}M\left(1,2,4,7\right), $ then

$\overbar{G}$ $+ F=\sum\_{}^{}m($) (write $\overbar{G}$ $+ F$ as a sum-of-minterms)**(2 Points)**

1. The data **001010** (which contains **EVEN** parity for error detection) was sent **four** times. The received data (for these 4 times) are shown below from **a** to **d**, circle **ALL** the data that the receiver **can’t detect** as being wrong: **(2 Point)**
2. **101010 b) 001011 C) 110011 d) 000000**
3. What is the minimum number of bits required to represent the **360** Latitudes? **\_\_\_\_\_\_** . The number of unused codes will be **\_\_\_\_\_\_\_** (Fill in the spaces) **(2 Point)**
4. Given that (521)**X** = (337)**10**, then the Base **X** is (circle one): **(2 Point)**
5. **4 b) 16 C) 8 d) 6**
6. **For the Logic Diagram Below:
7. **The logic function F = \_\_\_\_\_\_\_\_\_\_\_\_\_** (as in the logic diagram without anyre-arrangement) **(1 Point)**
8. This circuit has **\_\_\_**  number of logic levels (Fill in the space) **(1 Point)**
9. Assuming that all gates have a delay of 1 (each), then the longest path’s (i.e. critical path) delay = **\_\_**  **(1 Point)**

**Question 2. (17 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 **4 bits** only). Show your solution steps below the table. **(11 Points)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Decimal** | **Binary** | **Octal** | **Hexadecimal** | **BCD** |
| **105.25** |  |  |  |  |
|  | **11010.001** |  |  |  |
|  |  |  | **63.A** |  |
|  |  |  |  | 10010110 |

**2)** Perform the following arithmetic operations in the specified number system. **(6 Points)**

|  |  |  |
| --- | --- | --- |
| HexadecimalAddition B3+ 9A--------------- | BinarySubtraction 100001- 010011------------------  | Binary Multiplication 1101× 0101----------------  |

**Question 3. (19 Points)**

1. Using Boolean Algebraic manipulations, **minimize** the following two functions to **minimum** number of literals in **sum of products** representation (**show your work clearly step by step**):
2. $F=B \overbar{C}+ \overbar{A} D+A C + A\overbar{B}\overbar{C}$**(4 Points)**
3. $F=\left(A+B\right)\left(\overbar{A}+BC\right)+ A C$ **(4 Points)**

1. Find the **complement** of the following function F without performing any simplification : **(2 Points)**

$$F=\left(A+B\overbar{C}\right)\left(\overbar{A}+BCD\right)+ \overbar{A C}$$

1. Given the function F(A,B,C) represented in the given truth table: **(4 Points)**

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | C | F |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

1. Express **F** in **algebraic form** as a **sum-of-minterms. (2 Points)**
2. Express **F** in **algebraic form** as a **product of maxterms***.* **(2 Points)**
3. Using **Canonical forms**, determine whether the following two functions are equivalent or not: **(5 Points)**

 $F\_{1}\left(A, B, C\right)=\overbar{A} \overbar{B} + A B \overbar{C }$

$$F\_{2}(A, B, C)=(A+\overbar{B})(\overbar{A}+ B)(\overbar{B}+\overbar{C})$$