**電工實驗(一)**

**實驗報告**

**實驗單元(5)**

**組合邏輯閘**

**與**

**數位碼轉換電路**

**(電路模擬)**

**班別：**

**組別：**

**姓名：**

**★各項實驗紀錄(藍色字體)、撰寫實驗波形分析與實驗數據分析(藍色字體)、撰寫實驗問題與討論(藍色字體)、撰寫實驗結論(藍色字體)、按時繳交實驗報告(遲交扣分)，非(藍色字體)扣分。**

**◎總分=100分。**

**一、實驗模擬注意事項**

**★模擬注意事項：**

|  |  |  |
| --- | --- | --- |
|  |  | **Part Reference=DSTM3不能使用重覆名稱。** |

1. **數位模擬元件不要選錯資料庫―Pspice-74LS系列。**
2. **接線要接好線，不要與元件太靠近。**
3. **要設定節點名稱。**
4. **IC的VCC，GND接腳不用接上+5V，GND。**
5. **使用CLK時要算一下周期，Time Domain要Run 多長時間?一般跑3個循環就OK。**
6. **系統清除(Reset)動作一定要設定，之後若有使用到暫存器或正反器，一般都要先清除為0，初始狀態。**

**二、實驗項目與實驗步驟**

**本單元實驗項目有項目(一)至項目(五)等5項，模擬電路其中項目(一)至項目(四)必選，實作項目必選項目(三)及項目(五)。**

**◎實作項目(一)：設計實例電路模擬**

**1.題目：設計一個具有四個輸入A4A3A2A1和一個輸出F1的組合電路。**

**a.假設A3=0且A4=1時，則輸出F1必須等於1。**

**b.假設A2或A1任一等於1且A3=1時，則輸出F1亦須等於1。**

**c.其他情形輸出 F1=0。**

**2.依模擬結果，請寫出上述設計要求的真值表。**

**表(5-1)：設計實例真值表**

| **輸入** | | | | **輸出** |
| --- | --- | --- | --- | --- |
| **A4** | **A3** | **A2** | **A1** | **F1** |
| **0** | **0** | **0** | **0** |  |
| **0** | **0** | **0** | **1** |  |
| **0** | **0** | **1** | **0** |  |
| **0** | **0** | **1** | **1** |  |
| **0** | **1** | **0** | **0** |  |
| **0** | **1** | **0** | **1** |  |
| **0** | **1** | **1** | **0** |  |
| **0** | **1** | **1** | **1** |  |
| **1** | **0** | **0** | **0** |  |
| **1** | **0** | **0** | **1** |  |
| **1** | **0** | **1** | **0** |  |
| **1** | **0** | **1** | **1** |  |
| **1** | **1** | **0** | **0** |  |
| **1** | **1** | **0** | **1** |  |
| **1** | **1** | **1** | **0** |  |
| **1** | **1** | **1** | **1** |  |

**3.使用卡諾圖(需畫出)化簡輸出函數，推導、並寫出此函數。**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **A2A1**  **A4A3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | |
| **※推導布林代數方程式：F1＝** |

**4.附上實驗電路圖：使用NAND(74LS00、74LS10)以最少的IC數，來繪製邏輯電路圖。**

**FIG(5-1)：實驗模擬電路圖**

**5.檢驗實驗模擬結果。**

**FIG(5-2)：實驗模擬結果**

**6.附上模擬結論與說明。**

**◎實作項目(二)：二進碼至葛雷碼的轉換電路模擬**

**1.實驗題目：**

**a.設計一個具有四個輸入和四個輸出的組合電路，將四位元二進位數位碼轉換成等效的四位元葛雷碼。**

**b.利用互斥或閘來製作此電路。**

**2.完成真值表。**

**表(5-2)：四位元的二進碼至葛雷碼轉換表**

| **Input Binary Code** | | | |  | **Output Gray Code** | | | | **數值** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **C4** | **C3** | **C2** | **C1** |  | **G4** | **G3** | **G2** | **G1** | **顯示** |
| **0** | **0** | **0** | **0** |  | **0** | **0** | **0** | **0** | **0** |
| **0** | **0** | **0** | **1** |  | **0** | **0** | **0** | **1** | **1** |
| **0** | **0** | **1** | **0** |  | **0** | **0** | **1** | **1** | **3** |
| **0** | **0** | **1** | **1** |  | **0** | **0** | **1** | **0** | **2** |
| **0** | **1** | **0** | **0** |  | **0** | **1** | **1** | **0** | **6** |
| **0** | **1** | **0** | **1** |  | **0** | **1** | **1** | **1** | **7** |
| **0** | **1** | **1** | **0** |  | **0** | **1** | **0** | **1** | **5** |
| **0** | **1** | **1** | **1** |  | **0** | **1** | **0** | **0** | **4** |
| **1** | **0** | **0** | **0** |  | **1** | **1** | **0** | **0** | **12** |
| **1** | **0** | **0** | **1** |  | **1** | **1** | **0** | **1** | **13** |
| **1** | **0** | **1** | **0** |  | **1** | **1** | **1** | **1** | **15** |
| **1** | **0** | **1** | **1** |  | **1** | **1** | **1** | **0** | **14** |
| **1** | **1** | **0** | **0** |  | **1** | **0** | **1** | **0** | **10** |
| **1** | **1** | **0** | **1** |  | **1** | **0** | **1** | **1** | **11** |
| **1** | **1** | **1** | **0** |  | **1** | **0** | **0** | **1** | **9** |
| **1** | **1** | **1** | **1** |  | **1** | **0** | **0** | **0** | **8** |

**3.依模擬結果，請寫出上述設計要求的全及項、卡諾圖及以化簡布林代數。**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **a.G4＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **C2C1**  **C4C3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | | **b.G3＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **C2C1**  **C4C3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | |
|  |  |
| **c.G2＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **C2C1**  **C4C3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | | **d.G1＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **C2C1**  **C4C3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | |

**4.附上實驗電路圖，利用互斥或閘來製作此電路(74LS86)。**

**FIG(5-3)：實驗模擬電路圖**

**5.檢驗實驗模擬結果，需要使用匯流排顯示輸出結果。**

**FIG(5-4)：實驗模擬結果**

**6.附上模擬結論與說明。**

**◎實驗項目(三)：解碼器之製作電路模擬**

**1.題目：製作具有三個輸入B3，B2，B1和三個輸出 F2、F3、F4的組合電路。利用一個74LS155解碼器IC特性及NAND閘(74LS10)來製作及測試此組合電路。若電路已經化簡為布林函數如下：**

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**2.寫出上述完整的布林函數及其真值表。**

**表(5-3)：解碼器之製作真值表**

| **輸入** | | | **輸出** | | |
| --- | --- | --- | --- | --- | --- |
| **B3** | **B2** | **B1** | **F2** | **F3** | **F4** |
| **0** | **0** | **0** |  |  |  |
| **0** | **0** | **1** |  |  |  |
| **0** | **1** | **0** |  |  |  |
| **0** | **1** | **1** |  |  |  |
| **1** | **0** | **0** |  |  |  |
| **1** | **0** | **1** |  |  |  |
| **1** | **1** | **0** |  |  |  |
| **1** | **1** | **1** |  |  |  |

**3.說明如何設計此電路。**

**◎說明：**

**4.附上實驗電路圖。**

**FIG(5-5)：實驗模擬電路圖**

**5.檢驗實驗模擬結果。**

**FIG(5-6)：實驗模擬結果**

**6.附上模擬結論與說明。**

**◎實驗項目(四)：9的補數器電路模擬**

**1.實驗題目：**

**a.試設計一組合電路，有四條以BCD碼代表十進位數的輸入線，四條可以產生輸入位元9的補數的4條輸出線。**

**b.提供第五條輸出以檢測出在輸入BCD數中的錯誤。即四個輸入具有BCD碼未使用組合中任一個時，這個輸出必須等於邏輯1。**

**c.可使用任何邏輯閘來製作，但所用總IC數應量減少。**

**2.完成真值表。**

**表(5-4)：9的補數器**

| **BCD Code** | | | |  | **9的補數** | | | | **check** | **數值** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **B4** | **B3** | **B2** | **B1** |  | **C4** | **C3** | **C2** | **C1** | **K** | **顯示** |
| **0** | **0** | **0** | **0** |  |  |  |  |  |  |  |
| **0** | **0** | **0** | **1** |  |  |  |  |  |  |  |
| **0** | **0** | **1** | **0** |  |  |  |  |  |  |  |
| **0** | **0** | **1** | **1** |  |  |  |  |  |  |  |
| **0** | **1** | **0** | **0** |  |  |  |  |  |  |  |
| **0** | **1** | **0** | **1** |  |  |  |  |  |  |  |
| **0** | **1** | **1** | **0** |  |  |  |  |  |  |  |
| **0** | **1** | **1** | **1** |  |  |  |  |  |  |  |
| **1** | **0** | **0** | **0** |  |  |  |  |  |  |  |
| **1** | **0** | **0** | **1** |  |  |  |  |  |  |  |
| **1** | **0** | **1** | **0** |  |  |  |  |  |  |  |
| **1** | **0** | **1** | **1** |  |  |  |  |  |  |  |
| **1** | **1** | **0** | **0** |  |  |  |  |  |  |  |
| **1** | **1** | **0** | **1** |  |  |  |  |  |  |  |
| **1** | **1** | **1** | **0** |  |  |  |  |  |  |  |
| **1** | **1** | **1** | **1** |  |  |  |  |  |  |  |

**3.利用全及項與卡諾圖，以化簡布林代數。**

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| **a.C4＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **B2B1**  **B4B3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | | | | | | | | **b.C3＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **B2B1**  **B4B3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | |
|  | | | | | | |  |
| **c.C2＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **B2B1**  **B4B3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | | | | | | | | **d.C1＝\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **B2B1**  **B4B3** | **00** | **01** | **11** | **10** | | **00** |  |  |  |  | | **01** |  |  |  |  | | **11** |  |  |  |  | | **10** |  |  |  |  | |
| **e.K＝\_\_\_\_\_\_\_\_\_\_\_** | | | | | | |  |
| **B2B1**  **B4B3** | **00** | **01** | **11** | **10** |
| **00** |  |  |  |  |
| **01** |  |  |  |  |
| **11** |  |  |  |  |
| **10** |  |  |  |  |

**4.附上實驗電路圖。**

**FIG(5-7)：實驗模擬電路圖**

**5.檢驗實驗模擬結果。**

**FIG(5-8)：實驗模擬結果**

**6.附上模擬結論與說明。**

**三、撰寫實驗模擬結論和心得**

**四、實驗綜合評論**

**1.實驗測試說明、實驗補充資料及老師上課原理說明，是否有需要改善之處。**

**2.實驗模擬項目內容，是否有助於個人對實驗電路測試內容的了解。**

**3.實驗測量結果，是否合乎實驗目標及個人的是否清楚瞭解其電路特性。**

**4.就實驗內容的安排，是否合乎相關課程進度。**

**5.就個人實驗進度安排及最後結果，自己的評等是幾分。**

**6.在實驗項目中，最容易的項目有那些，最艱難的項目包含那些項目，並回憶一下，您在此實驗中學到了那些知識與常識。**

**五、附上實驗進度紀錄單(照片檔)**