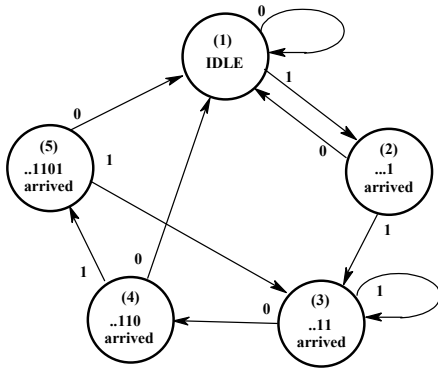
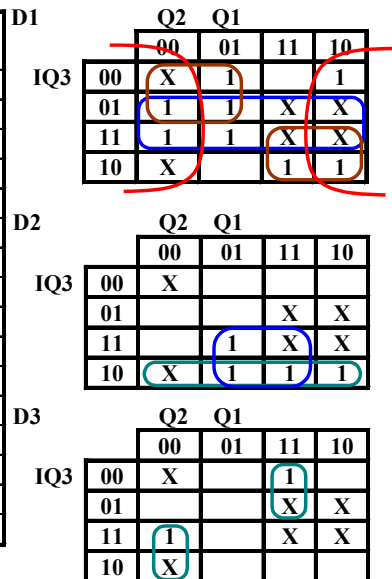


**DOC Course 112: Hardware: Tutorial 6 Solution
Problem 1**



Problem 2

| Input | State | State Type | Q3 | Q2 | Q1 | State | D3 | D2 | D1 |
|-------|-------|------------|----|----|----|-------|----|----|----|
| 0 | 1 | Idle | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 2 | ..1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 3 | ..11 | 0 | 1 | 1 | 4 | 1 | 0 | 0 |
| 0 | 4 | ..110 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 5 | ..1101 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 6 | | 1 | 1 | 0 | X | X | X | X |
| 0 | 7 | | 1 | 1 | 1 | X | X | X | X |
| 0 | 8 | | 0 | 0 | 0 | X | X | X | X |
| 1 | 1 | Idle | 0 | 0 | 1 | 2 | 0 | 1 | 0 |
| 1 | 2 | ..1 | 0 | 1 | 0 | 3 | 0 | 1 | 1 |
| 1 | 3 | ..11 | 0 | 1 | 1 | 3 | 0 | 1 | 1 |
| 1 | 4 | ..110 | 1 | 0 | 0 | 5 | 1 | 0 | 1 |
| 1 | 5 | ..1101 | 1 | 0 | 1 | 3 | 0 | 1 | 1 |
| 1 | 6 | | 1 | 1 | 0 | X | X | X | X |
| 1 | 7 | | 1 | 1 | 1 | X | X | X | X |
| 1 | 8 | | 0 | 0 | 0 | X | X | X | X |

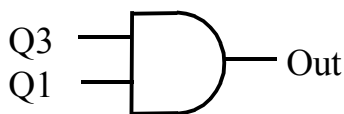


$$D3 = I \bullet Q2' \bullet Q1' + I' \bullet Q2 \bullet Q1$$

$$D2 = I \bullet Q3' + I \bullet Q1$$

$$D1 = Q3 + I' \bullet Q2' + I \bullet Q2 + Q1'$$

Problem 3



Problem 4

| Input | State | Q3 | Q2 | Q1 | Next State | D3 | D2 | D1 |
|-------|-------|----|----|----|------------|----|----|----|
| 0 | 6 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 7 | 1 | 1 | 1 | 5 | 1 | 0 | 1 |
| 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 6 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 7 | 1 | 1 | 1 | 3 | 0 | 1 | 1 |
| 1 | 8 | 0 | 0 | 0 | 7 | 1 | 1 | 1 |

The circuit is safe and will not get stuck in states 6,7 or 8