CSE435 Introduction to EDA & Testing - Spring 2022 Homework Assignment #3 Shao-Hsuan Chu - B073040018

1. (20%) For a D F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

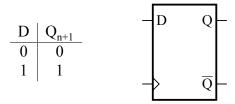


Figure 1: D F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick, and at the initial tick, Q_n is in the don't-care condition. For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

| D | Q_{n+1} | Functions |
|---|-----------|------------------------------|
| 0 | 0 | set 0 (with $Q_n = \times$) |
| 0 | 0 | set 0 (with $Q_n = 0$) |
| 1 | 1 | set 1 (with $Q_n = 0$) |
| 1 | 1 | set 1 (with $Q_n = 1$) |
| 0 | 0 | set 0 (with $Q_n = 1$) |

If output does not meet the expectation, a functional fault is detected in the F/F. One of the set-to-0 or set-to-1 functions could not behave properly.

2. (20%) For a T F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

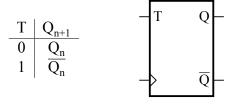


Figure 2: T F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick. Assume $Q_n = 0$ at the initial tick. (Todo: How to make such assumption?) For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

| T | Q_{n+1} | Functions |
|---|-----------|-------------|
| 0 | 0 | hold 0 |
| 1 | 1 | toggle to 1 |
| 0 | 1 | hold 1 |
| 1 | 0 | toggle to 0 |

If output does not meet the expectation, a functional fault is detected in the F/F. One of the hold or toggle to 0/1 functions could not behave properly.

3. (20%) For a J-K F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

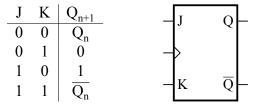


Figure 3: J-K F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick, and at the initial tick, Q_n is in the don't-care condition. For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

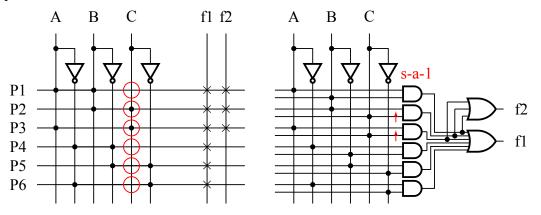
| J | K | Q_{n+1} | Functions |
|---|---|-----------|-------------|
| 0 | 1 | 0 | set 0 |
| 0 | 0 | 0 | hold 0 |
| 1 | 0 | 1 | set 1 |
| 0 | 0 | 1 | hold 1 |
| 1 | 1 | 0 | toggle to 0 |
| 1 | 1 | 1 | toggle to 1 |

If output does not meet the expectation, a functional fault is detected in the F/F. One of the set, hold or toggle to 0/1 functions could not behave properly.

PLA Faults, Given f1=AB+BC+CA+AB+BC+CA.
 Please draw AND-Array and OR-Array of Missing Crosspoint Faults in AND-OR Plane, and show the equivalent stuck fault representation.

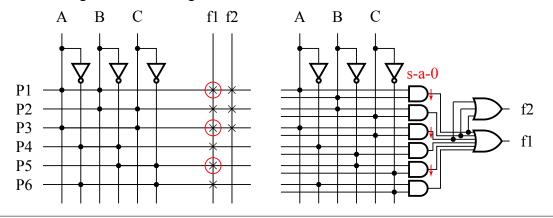
(a) Missing Crosspoint Faults: Missing C in AND Plane.

Solution: In the figure below, the red circles indicate the missing crosspoint faults, and the upward arrows indicate the s-a-1 faults. The missing crosspoint in the AND plane causes growth fault, i.e., the lines having crosspoint with C will no longer depend on C.



(b) Missing Crosspoint Faults: Missing P1, P3, P5 in f1 in OR Plane.

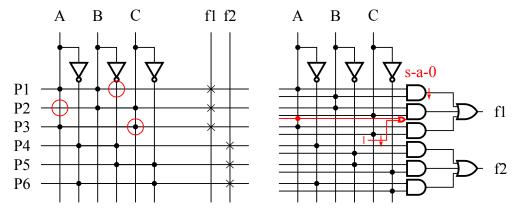
Solution: In the figure below, the red circles indicate the missing crosspoint faults, and the downward arrows indicate the s-a-0 faults. The missing crosspoint in the OR plane causes disappearance fault, i.e., the output having crosspoint with P1, P3 or P5 will no longer receive the signal from them.



- PLA Faults, Given f1=AB+BC+CA, f2=AB+BC+CA, f2=AB+BC+CA.
 (20%) Please draw AND-Array and OR-Array of Extra Crosspoint Faults in AND-OR Plane, and show the equivalent stuck fault representation.
 - (a) Extra Crosspoint Faults: Extra \overline{B} in P1, A in P2, C in P3 in AND Plane.

Solution: In the figure below, the red circles indicate the extra crosspoint faults, and the downward arrows indicate the s-a-0 faults. The missing crosspoint in the OR plane causes shrinkage or disappearance fault. For example, since P1 has a crosspoint

with B, an extra crosspoint on \overline{B} will make P1 always forward 0, i.e., the disappearance fault. On the other hand, P2 doesn't have crosspoint with \overline{A} initially, an extra crosspoint with A would make P2 depend on A, i.e., the shrinkage fault.



(b) Extra Crosspoint Faults: Extra P4, P5, P6 in f2 in OR Plane.

Solution: In the figure below, the red circles indicate the extra crosspoint faults. Since none of the extra crosspoint faults creates a new crosspoint. This PLA configuration should not be able to test out these faults.

