(a) Multiple-Input Signature Register (MISR)

Note:

\[ \text{Init: } Q_1 = 0, Q_2 = 0, Q_3 = 0 \]

1st edge:

\[ Q_1 = 0, Q_2 = 1, Q_3 = 1 \]

2nd edge:

\[ Q_1 = 1, Q_2 = 0, Q_3 = 0 \]
(a) Fault classes are:
\[ \{A \text{ s-a-0}, B \text{ s-a-0}, C \text{ s-a-0}, D \text{ s-a-1}\} \]
\[ , \{A \text{ s-a-1}\}, \{B \text{ s-a-1}\}, \{C \text{ s-a-1}\}, \{D \text{ s-a-0}\} \]
(we'll arbitrarily select \( D \text{ s-a-1} \) as the representative of the large class, but any other of its members is also ok.)

(b) Fault simulation is:

<table>
<thead>
<tr>
<th></th>
<th>ABC</th>
<th>D For:</th>
<th>good</th>
<th>As-a-1</th>
<th>Bs-a-1</th>
<th>Cs-a-1</th>
<th>Ds-a-0</th>
<th>Ds-a-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
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<td>011</td>
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<tr>
<td>111</td>
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</tbody>
</table>

-2-
(1) 000 \text{ detects } Ds-a-0
001 \quad Ds-a-0
010 \quad Ds-a-0
011 \quad As-a-1 \text{ and } Ds-a-0
100 \quad Ds-a-0
101 \quad Bs-a-1 \text{ and } Ds-a-0
110 \quad Cs-a-1 \text{ and } Ds-a-0
111 \quad Ds-a-1

\Rightarrow \text{ the minimal set of test vectors } ABC \text{ which detect all faults is: }
\{011, 101, 110, 111\}

\(3\) \(-15_{10} = -32 + 17 = -2^5 + 2^4 + 2^0 = \begin{bmatrix} 1 \ 0 \ 0 \ 0 \ 0 \ 1 \end{bmatrix}_2\)
\Rightarrow \text{As an unsigned number: }
32 + 16 + 1 = \begin{bmatrix} 49 \end{bmatrix}
4) \( q^{[5]} = \{5, 4, 3, 2, 1\} \)

1 2 3 4 (index #)

After \( q.\ delete(1) \):
\( \{5, 3, 2, 1\} \)

After \( q.\ delete(3) \):
\( \{5, 3, 2\} \)

\( \Rightarrow i = 0, q[i] = 5 \)
\( i = 1, q[i] = 3 \)
\( i = 2, q[i] = 2 \)

After \( q.\ insert(1, a) \):
\( \{5, 6, 3, 2\} \)

After \( q.\ insert(3, b) \):
\( \{5, 6, 3, 7, 2\} \)

\( \Rightarrow i = 0, q[i] = 5 \)
\( i = 1, q[i] = 6 \)
\( i = 2, q[i] = 3 \)
\( i = 3, q[i] = 7 \)
\( i = 4, q[i] = 2 \)
(a) header file
(b) wait statement
(since it is a METHOD)
(c) `sc_in<sc_uint<WIDTH>> d;

\[ \text{space needed} \]

`sc_out<sc_uint<WIDTH>> g;

(d) on the positive (or rising) edge of clk.