# COE 545, Term 002

Digital System Testing

HW#5

Q.1. Problem 9.4

Q.2. Problem 9.5

Q.3. Determine whether clock skew can lead to erroneous operation during shift operation for a scan register implemented using :

(i) MD-FF

(ii) 2P-FF

(iii) MD-SRL

(iv) 2P-SRL

Q.4. Problem 9.8

Q.5. Problem 9.9

Q.6. Problem 9.17

Q.7. Problem 10.16

Q.8. Given the characteristic polynomial $p(x)=1+x+x^4$:

(i) Is $p(x)$ a primitive polynomial? Justify your answer.

(ii) Show a Type 1 LFSR implementation of $p(x)$, and determine the sequence generated by the LFSR.

(iii) Show a Type 2 LFSR implementation of $p(x)$, and determine the sequence generated by the LFSR.

(iv) Determine the reciprocal polynomial $p^*(x)$.

(v) Show a Type 1 LFSR implementation of $p^*(x)$, and determine the sequence generated by the LFSR. Verify that it produces the reverse of the sequence generated by the one in (ii).

(vi) Show a Type 2 LFSR implementation of $p^*(x)$, and determine the sequence generated by the LFSR. Verify that it produces the reverse of the sequence generated by the one in (iii).

Q.9. Consider the circuit shown below, where a 3-stage LFSR is feeding a scan chain of length 8. Assume that the scan chain drives the gates G1 and G2 as shown and that G1

and G2 are connected to primary outputs. Determine whether the indicated single stuck-at faults can be detected by the LFSR or not. If a fault can be detected, determine the seed of the LFSR to generate the test for the fault.
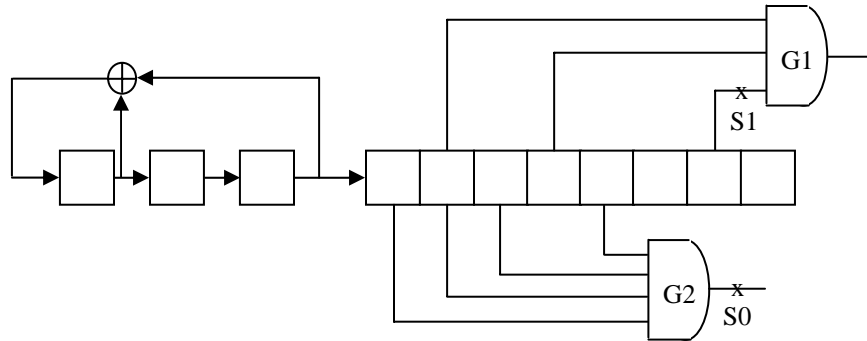
Q.10. OPUS is a partial scan package based on cycle breaking and testability measures. Consider the sequential circuit s5378.bench with 179 FFs.

(i) Perform full scan of the circuit using the command ***fullscan*** and determine the fault coverage and CPU time. This command converts scanned FFs into PIs and POs.

(ii) Perform full scan of the circuit using the command ***addmux -scan***. This command adds MUXs to scanned FFs and places them in a single scan chain. Determine the obtained fault coverage and CPU time, and compare them to what you obtained in (i). Comment on your observations.

(iii) Perform partial scan of the circuit scanning 20%, 30%, and 50% using each of the following commands. Compare the fault coverage and CPU time for each case. Use the ***makescan*** command to convert selected FFs to PIs and POs.

One.   *Opus -n -i*

Two.   *Opus -t -i*

Three.   *Opus -t*