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This assignment covers material from the lectures and the text Chapters 6 and 9.

Problem 1 (20 points) *Pseudoexhaustive testing*
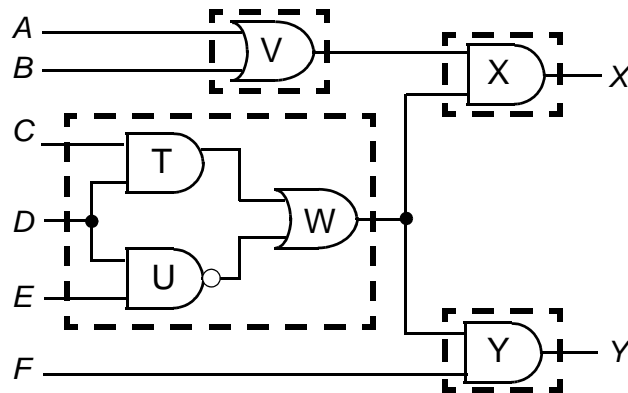

Fig. 1

(**a**) Let C be a combinational circuit with n primary inputs (PIs) and m primary outputs (POs) $z_1,z_2,\ldots,z_m$. Each PO z_i depends on (is a function of) n_i PIs, where $n_i \leq n$. C is said to be *exhaustively* tested if we apply all 2^n input combinations to its n PIs. C is said to be *pseudoexhaustively* tested if we apply all 2^{n_i} input vectors to all PIs feeding every PO z_i. Since we can have $n_i < n$, and the PI sets of two different POs can overlap, it's possible for the total number of pseudoexhaustive tests needed by C to be significantly less than 2^n. How many tests are needed to pseudoexhaustively test the circuit of Fig.1 above?

(**b**) A related testing method involves exhaustively testing a subcircuit SC with respect to its own inputs rather than with respect to the overall circuit C's PIs. (This corresponds the "cell fault" model that we discussed earlier.) In this case, we have to apply (possibly via other circuits) every possible input pattern to SC and propagate any resulting error (possibly via other circuits) to a PO.

Suppose we want to test each of the four subcircuits (partitions) indicated by dotted lines in Fig. 1 in this way. Find the smallest number of tests needed, and construct a minimum test set. If you're not sure if your test set is minimal, construct the smallest test you can and estimate how close it is to being minimal.

Problem 2 (20 points) *Memory tests*
(**a**) Text, page 308, Problem 9.12.
(**b**) Text, page 308 Problem 9.22.

Problem 3 (20 points) *Combinational SCOAP*

Text, Page 151, Problem 6.5.
In this problem, put your testability figures on the circuit diagram using the same notation $(CC0,CC1)CO$ as the text, e.g., Fig. 6.10.

Problem 4 (20 points) *Combinational and sequential SCOAP*
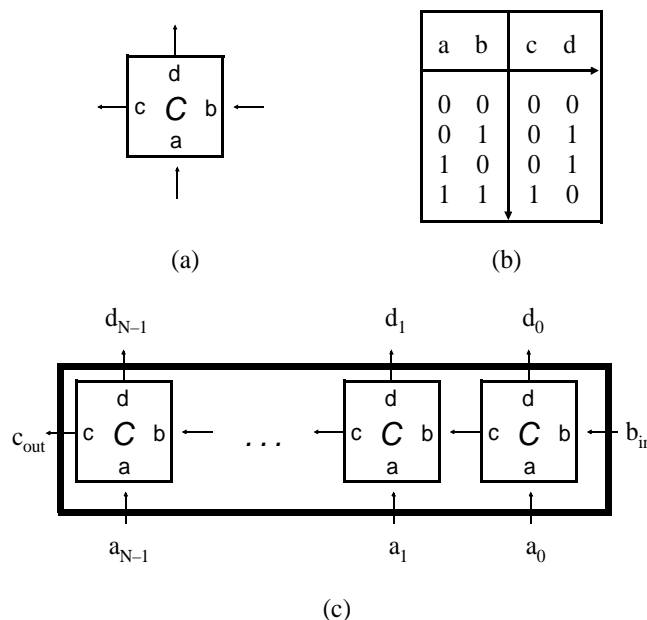
Text, Page 153, Problem 6.13.
Again, put your testability figures on the circuit diagram using the combinational measures $(CC0,CC1)CO$ and the sequential measures $[SC0,SC1]SO$ as in the text.

Problem 5 (20 points) *C-testability*

Figure 2a below shows a 2-input, 2-output functional cell *C*, whose behavior is described by the truth table of Fig. 2b. It can be used to form an iterative logic array (ILA) as shown in Fig. 2c.

(**a**) Determine whether or not the ILA is C-testable, assuming that each individual cell must be tested exhaustively for all functional faults. Give clear reasons for your answer.

(**b**) If the ILA is C-testable, show how to construct a complete test set for an *N*-cell ILA using the minimum (constant) number of test patterns. If it is not C-testable, then also show how to construct a complete test set for an *N*-cell ILA using the minimum (non-constant) number of test patterns.

a	b	c	d
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

(a)   (b)

Fig. 2

(c)

End of Homework No. 4 (5 problems, 100 points)