COE 561, Term 051
Digital System Design and Synthesis
HW# 4
Due date: Tuesday, Dec. 6

Q.1. Consider the logic network defined by the following expressions:

$$x = a\ b\ d\ e' + c\ d'\ e + c\ d\ e' + a\ b\ d'e + a\ b\ c$$
$$y = ab + c$$

(i) Substitute y into f_x by performing the algebraic division f_x/f_y. Show all steps. Determine the number of literals saved.

(ii) Compare your solution with the result obtained by running the sis command ***resub –d*** (resubstitute without complement).

Q.2. Consider the following function:

$$x = a\ c\ h + b\ c\ h + d\ g\ h + e\ g\ h + f\ g\ h + i$$

(i) Compute all the kernels of *x* using the recursive kernel computation algorithm. Show all the steps.

(ii) Compute all the kernels of x based on matrix representation. Compare your answer to the result obtained in (i).

Q.3. Consider the following function:

$$x = a\ c + b\ c + b\ e + d\ c + d\ e$$

(i) Find a quick factor of *x* by using the first level-0 kernel found. Assume that input variables are sorted in lexicographic order. Determine the number of literals obtained. Compare your solution with the result obtained by running the sis commands ***factor –q x; print_factor; print_stats –f.***

(ii) Find a good factor of *x* based on using the best kernel. Determine the number of literals obtained. Compare your solution with the result obtained by running the sis commands ***factor –g x; print_factor; print_stats –f.***

Q.4. Consider the logic network defined by the following expressions:

$$x = a\,c\,d + a\,e\,f' + a\,e'\,g' + a'\,b'\,c' + a'\,b'\,d' + a'\,b'\,e\,f + a'\,b'\,e'\,g + b\,c\,d$$

(i) Compute all double-cube divisors of *x* along with their bases.

(ii) Apply the fast extraction algorithm based on extracting double-cube divisors along with complements or single-cube divisors with two-literals. Show all steps of the algorithm. Determine the number of literals saved. Compare your solution with the result obtained by running the sis commands ***fx***.

Q.5. Consider the logic network defined by the following expressions:

$d = a + b$
$e = b' + c$
$f = c\,d + a\,e + b\,c'$

Inputs are {a, b, c} and output is {f}.

(i) Compute CDC for the cut including the inputs of functions f.

(ii) Compute the SDC set for nodes d and e.

(iii) Using the CDC set of node f and the SDC for nodes d and e, simplify the function f.

(iv) Compute the ODC set for node e. Consider the network perturbation replacing e by 0, i.e. $\delta = (b'+c) \oplus 0 = b' + c$. Determine if this perturbation is feasible or not. Is the fault **e stuck-at-0** testable. If it is testable find all tests detecting the fault. If the fault is untestable optimize the network by eliminating redundancy.

(v) Apply the sis command ***full_simplify*** and compare the solution obtained with your obtained solution based on optimizations made in (iii) & (iv).