

**COE 561, Term 091**  
**Digital System Design and Synthesis**

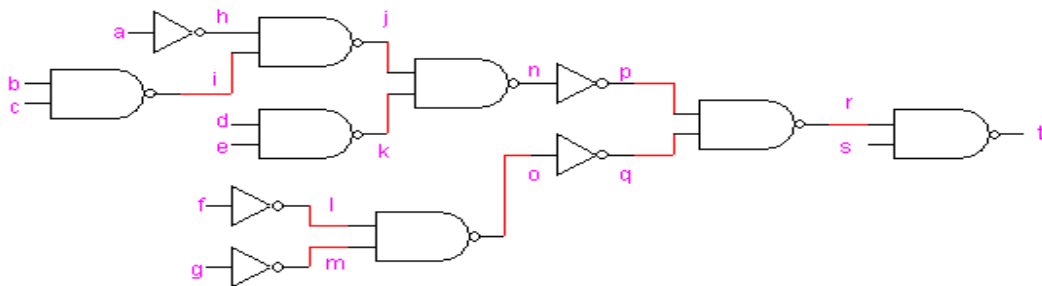
**HW# 4**

**Due date: Tuesday, Jan. 19**

**Q.1.** Consider a technology library containing the following cells:

Cell	Area Cost
$INV(x1) = x1'$	1
$NAND2(x1, x2) = (x1 \ x2)'$	2
$NAND3(x1, x2, x3) = (x1 \ x2 \ x3)'$	3
$NOR2(x1, x2) = (x1 + x2)'$	2
$AOI21(x1, x2, x3) = ((x1 \ x2) + x3)'$	3
$OAI21(x1, x2, x3) = ((x1+x2) \ x3)'$	3
$AOI22(x1, x2, x3, x4) = (x1 \ x2 + x3 \ x4)'$	4
$OAI22(x1, x2, x3, x4) = ((x1+x2) \ (x3+x4))'$	4

- (i) Show the **pattern trees** of the library cells using **NAND2** and **INV** as base functions. Assume that symmetric representations do not need to be stored.
- (ii) Using the dynamic programming approach, **map** the circuit given below using the given library into the **minimum area** cost solution. Inputs are  $\{a, b, c, d, e, f, g\}$  and output is  $\{Z\}$ .
- (iii) Using the given library, use the SIS command *read\_libray q1.lib* to read the library. Then, map the circuit to the library using the sis command *map -s -m 0*. Compare your solution to the solution obtained in (iii) and comment on any differences. You can save the mapped circuit using the sis command *write\_blif -n*.



**Q.2.** Assuming **Boolean matching**, determine the number of ROBDD's that need to be stored in the cell library for each of the following cells. Justify your answer.

(i)  $f = a \oplus b \oplus c$

(ii)  $f = a b + a c + b c$

(iii)  $f = a b + a' b' + a c + b c$