ESE 461: Design Automation for Integrated Circuit Systems

Homework 1

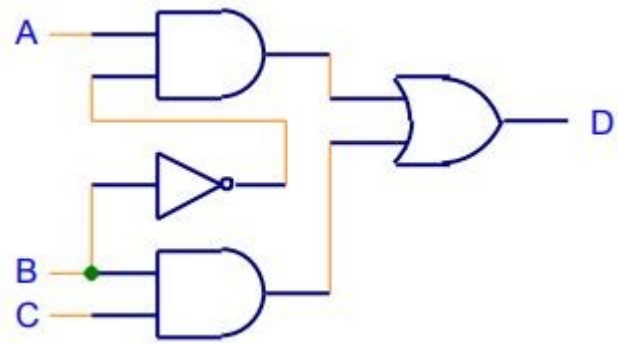## Due: Sep 5th, 5:00pm, homework bin labeled "ESE461" in Green Hall

1. Write the Boolean expression in Product of Sum (POS) form for the truth table to the right. Complete the Karnaugh Map and simplify the Boolean expression.

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

BC

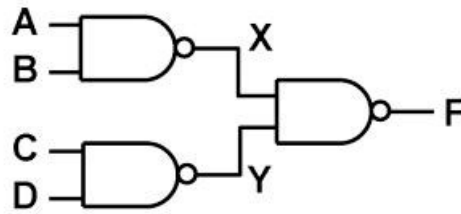|	00	01	11	10
A 0				
1				

2. Given the following digital logic gates:

a) Fill out the truth table for the circuit.

b) What is the function of the circuit?

3. Design a combinational circuit that accept a 3-bit number and generates a 6-bit binary number output equal to the square of the input number. (Hint: first derive the truth table.)

4. Consider the following static CMOS logic design:

c) Write down the Boolean expression for the logic function F using inputs A, B, C, and D implemented by the logic gates in the above figure.

d) Give the circuit in above figure using static CMOS circuits for the individual logic gates (hint: each NAND gate can be composed of a two-input AND gate and a NOT gate). Be sure to label all inputs, outputs, and other circuit nodes.

5. Design a finite-state machine for a sequence detector that detects a sequence of 011 on a single input X. (Hint: first design the state representation, then derive the state transition diagram, and finally use the truth table to map out the combinational logic.)

Required Reading Assignments:

 Textbook –

Microelectronic Circuits (7th Edition), by Sedra & Smith

Appendix 1

Chapter 5.1, 5.2, 15.1

Digital Integrated Circuits (2nd Edition), by Jan M. Rabaey, Anantha Chandrakasan, Borivoje
Nikolic.

Chapter 2 (2.5 optional),

Chapter 3.3, 3.4 (optional)

Required Video about integrated circuit (IC) fabrication and how transistor works:

1. IC fabrication
   https://www.youtube.com/watch?v=35jWSQXku74
   https://www.youtube.com/watch?v=AOaJFKWXYY0
2. How transistor works
   https://www.youtube.com/watch?v=IcrBqCFLHIY
   https://www.youtube.com/watch?v=7ukDKVHnac4

Recommended optional video for in-depth understanding of transistor operation:

Razavi Electronics Lecture 1, 2, 3

https://www.youtube.com/watch?v=yQDfVJzEymI&list=PL7qUW0KPfsIIOPOKL84wK_Qj9N7gvJX6v&index=1

https://www.youtube.com/watch?v=NWolpDgi6_Y&list=PL7qUW0KPfsIIOPOKL84wK_Qj9N7gvJX6v&index=2

https://www.youtube.com/watch?v=mhtYm-USVD8&index=3&list=PL7qUW0KPfsIIOPOKL84wK_Qj9N7gvJX6v