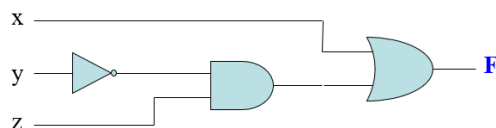


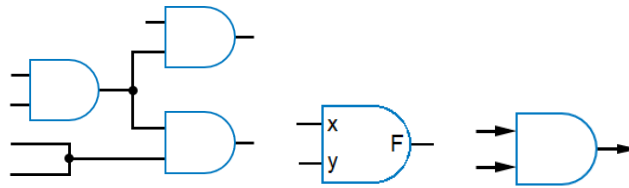
## 70 Questions for VE270 Midterm Exam Review

### VE270 2019 Fall TA Group

1. How do digital signals and analog signals look like?
2. How to convert binary numbers to decimal numbers?  
Example:  $(1101.011)_2 = ( \quad )_{10}$
3. What are the two methods to convert decimal numbers to binary numbers?  
Example:  $(19.25)_{10} = ( \quad )_2$
4. How to convert among binary numbers, octal numbers, and hexadecimal numbers?
5. How to convert base-m numbers to base-n numbers?
6. How do we encode text with binary bits?
7. What is 1's complement or 2's complement representation of binary numbers? How to store signed binary numbers using 2's complement method?  
Example:  $(-57)_{10} = ( \quad )_2$
8. How to do addition or subtraction for two binary numbers? What about octal or hexadecimal?  
Example:  $(6FE58C + A3DD)_{16} =$
9. What are the two methods to detect overflow?  
Example:  $(532 - 265)_8 =$
10. How many transistors are needed for AND/OR/NOT logic? How to implement these logic gates using transistors? What about other logics (NAND/NOR/XOR...)?
11. What is the truth table used for? How to draw a truth table?  
Example: Draw a truth table for the XNOR logic gate.
12. What is the precedence of logic operations among AND, OR, and NOT?
13. How to convert between logic equation and logic gates?  
Example: Convert  $F = a \text{ AND } NOT(b \text{ OR } NOT(c))$  to logic gates.
14. How to build a truth table according to the given logic gates?  
Example: Convert the following circuit to a truth table.

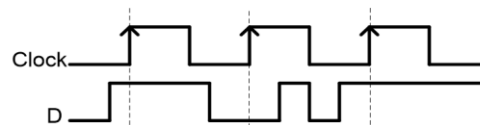


15. What is a timing diagram? How to draw?
16. Can you find the mistake in the following figures?



17. In Boolean algebra, what is “variable”, “literal”, “product term”, “sum term”, and “sum-of-products”?  
Example: In  $F(a, b, c) = a'bc + abc' + ab + c$ , find all the variables, literals, product terms, sum terms, and sum-of-products.
18. Are you familiar with the basic theorems of Boolean algebra? Can you use them to simplify logic expressions?  
Example: Simplify  $F = (x + y)(x + y')$ ,  $G = x + x'y$ ,  $H = wx'y' + wxz' + wx'yz'$ .
19. What is DeMorgan’s Law?  
Example: Simplify  $F = ((AB' + C)D' + E)'$ .
20. Are you familiar with the XOR properties?
21. What are the minterms and maxterms? What does “standard-sum-of-products” mean? What is the relationship between minterm and maxterm?
22. How to convert a logic equation to sum-of-minterm form?
23. What is the critical path?
24. How to optimize a logic expression using K-map? How to draw K-map?  
Example: Use K-map to simplify  $F = X'Y'Z' + X'Y'Z + X'YZ + X'YZ' + XYZ + XYZ'$
25. What is “don’t care”? Which letter do we use to represent “don’t care”?
26. What are “prime implicants” and “essential prime implicants”?
27. What is combinational circuit? What is sequential circuit?
28. What are the three steps to design combinational circuits?
29. What is multiplexor (MUX)? Truth table? Gate level implementation?

30. What is a half adder and full adder? Truth table? Gate level implementation?
31. What is the Carry-Ripple Adder? How to implement such an adder with 4-bit input?
32. How to modify the Carry-Ripple Adder to do subtraction for 2's complement numbers?
33. What is Arithmetic-Logic Unit (ALU)?
34. What is encoder and decoder? Truth table? Gate level implementation?
35. Why do we use buffers?
36. What is tri-state buffer? Truth table?
37. What is the characteristic table? Difference between characteristic table and truth table?
38. What is SR latch? Characteristic equation? Characteristic table? Gate level implementation?
39. What is gated SR latch and gated D latch? Characteristic table? Gate level implementation?
40. What is D flip flop? Characteristic equation? Characteristic table?  
Example: For a D flip flop, draw the timing diagram for output Q.



41. What are the differences between latch and flip flop?
42. What is J-K flip flop and T flip flop? Characteristic equation? Characteristic table?
43. What is a register? How to implement the register using flip flops?
44. To describe control inputs for flip flops, we use “asynchronous” or “synchronous”, “active low” or “active high”. What do they mean?  
Example: In a D flip flop, can you draw timing diagram for the output Q when there is an active low asynchronous clear? What about a D flip flop with an active low synchronous clear?
45. What do the following keywords mean in Verilog? What's the syntax of “always”, “case”, “if”?  
module, input, output, wire, assign, always, if, case, posedge, parameter.
46. How to use “assign” in Verilog?  
Example: Design a 2-bit comparator in at least two different methods using Verilog.

47. Can you design a D flip flop using Verilog? How to implement synchronous or asynchronous reset?
48. What's the difference between blocking procedural assignment (=) and non-blocking procedural assignment (<=)?
49. How to write testbench? What is it used for?
50. When will be "unwanted latch" generated? How to fix?
51. How to implement an asynchronous binary counter? Is there any problem?
52. How to design a synchronous binary counter?  
Example: Design a 3-bit binary counter using D flip flops.
53. How do we design a synchronous binary counter using Verilog?
54. How to implement control signals "CE", "load"? What is "CEO"? How to design such a counter with control signals and "CEO" output using Verilog?
55. How to customize counting sequence?  
Example: Design a 3-bit counter counting only prime numbers ( $2 \rightarrow 3 \rightarrow 5 \rightarrow 7 \rightarrow 2 \dots$ ).
56. What is a clock divider?  
Example: Design a 6-fold clock divider.
57. Why do we need output synchronization? How to synchronize the output?
58. What is a ring counter? How to implement?
59. What is a Johnson counter? How to implement?
60. What is a BCD counter? How to implement a 2-digit BCD counter?
61. How to design a up counter or down counter using incrementer or decrements?
62. How to design a register with synchronous parallel load?
63. What is register file? What is the input and what is the output?
64. What is shift register? How to implement using D flip flops? How to design using Verilog?
65. What is rotate register? How to implement using D flip flops? How to design using Verilog?

66. How to design a “universal shift register”? What is the input of the universal shift register?
67. What is a shifter? What’s the difference between “shifter” and “shift register”?
68. How to implement a shifter? How to design a shifter using Verilog?
69. How to use shifters to do multiplication?  
Example: Using one 4-bit shifter and one 4-bit adder to design a device such that when the input is  $x$ , the output is  $5x$ .
70. How to design a shifter that can shift by any amount?