

Microelectronics Systems Design ECE 446
Fall 2002 Test 2

1. What are the design principles for pullup/pulldown complementary networks? (5 points)

2. Define the logical operation performed by an AOI-211 gate (4 points)

3. Draw the transistor schematic and standard symbol of a CMOS transmission gate? (3 points)

4. Describe the three modes of power consumption for CMOS systems. (6 points)

5. What are the two mechanisms (dynamic and static) for information storage (memory) in a CMOS circuit? (4 points)

6. Draw the transistor schematic of a clocked inverter. Label the input, output, and clock signals. (4 points)

7. Name and draw the standard symbol for the 8 standard logic gates. (8 points)

8. Define (3 points each)

(a) non-overlapping clock

(b) glitch

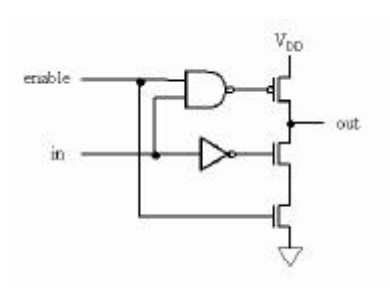
(c) shift register

(d) tri-state buffer

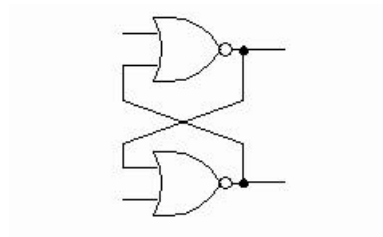
9. Design a 4-1 multiplexer using transmission gates. Show your results as a logic diagram using the standard logic symbol for a transmission gate. Label the control signals as S_0 and S_1 , the inputs as $A \cdots D$, and the output as OUT. (5 points)

10. Design a D-latch from an SR-latch and an inverter. (5 points)

11. Identify the following components. (4 points)



(a) _____



(b) _____

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12. Design a CMOS circuit for an XOR gate, using transmission gates and inverters. Show the resulting transistor circuit. (5 points)

13. Calculate the frequency of a 31-inverter ring oscillator if the delay of one inverter is 300 psec. (5 points)

14. Draw and label the circuit diagram of a Schmidt trigger. Briefly explain how it operates(10 points)

15. Design a master-slave D-flip-flop using one or more quasi-static recirculating latches? (10 points)

16. Consider a uniform polysilicon wire with a length of 400 μm and a width of 2 μm . Assume a sheet resistance of 20 Ω/square and a plate capacitance of 0.08 fF/ $(\mu\text{m})^2$. Find the Elmore propagation delay from one end of the wire to the other. (5 points)

17. Design a CMOS circuit to generate the logic function $\overline{((AB) + C)D}$. Draw a transistor circuit diagram for your design. (5 points)