Comparators

## NAND/NOR logic. (see lecture 15 and 16)

**20.** Implement the logic circuits in Figure 5–54 using only NAND gates.

**21.** Implement the logic circuit in Figure 5–58 using only NAND gates.

**22.** Repeat Problem 20 using only NOR gates.

**23.** Repeat Problem 21 using only NOR gates.

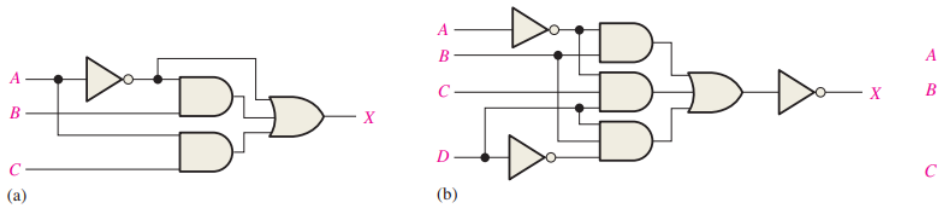



FIGURE 5–54

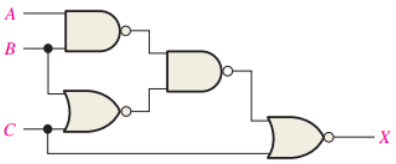
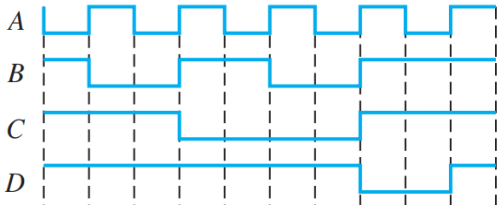



FIGURE 5–58

Remember, these circuits can be given to you in terms of logic expressions such as $X = \overline{(\bar{A} + \bar{B} + \bar{C})DE}$ & $X = \overline{\bar{A}\,\bar{B}\,\bar{C} + (D + E)}$

## Adders & Comparators

Consider ABCD as a number, with D as LSB, and add the number to itself to write the outputs.




**11.** Each of the eight full-adders in an 8-bit parallel ripple carry adder exhibits the following propagation delay:

| | |
|---|---|
| $A$ to $\Sigma$ and $C_{out}$: | 20 ns |
| $B$ to $\Sigma$ and $C_{out}$: | 20 ns |
| $C_{in}$ to $\Sigma$: | 30 ns |
| $C_{in}$ to $C_{out}$: | 25 ns |

Determine the maximum total time for the addition of two 8-bit numbers.

Draw the comparator circuit that can compare two 8-it numbers using 4-bit comparator circuit.

Practice questions for Mux/DeMux and Decoder/Encoders are enough from the assignment.