

CPE/EEE 64 PAL Worksheet ECS, CSUS

Logic Gates Worksheet

Example 1) Given two eight-bit numbers A = 1011_0001, B = 1010_1100, find (A AND B) (logical AND operation)

$$\begin{array}{r} A = 1011_0001 \\ B = 1010_1100 \\ \hline 1010_0000 \\ \hline \end{array}$$

- 1) Given two eight-bit binary numbers A = 1000_1101 and B = 1100_1011, find (A OR B) (Logical OR operation).
- 2) Given two eight-bit binary numbers A = 0110_0101 and B = 1001_0101, find (A XOR B) (Logical XOR Operation).

Example 2: What type of gate would you use to implement a simple intrusion alarm system? The system should have 3 window sensors (inputs). If any one or more of the windows is broken into, then the corresponding sensor generates a High ("1") signal and the alarm signal should be High ("1") output.

Solution: I can use a 3-input "OR" gate to implement this alarm system. For OR gate, if any one or more of the inputs are High, then the Output is High. The 3 window sensors can be the inputs of the OR gate. The output of the OR gate is connected to the alarm signal.

- 3) What type of logical operation would you use to decide when applying to your dream college? Your dream college should meet ALL of the following criteria. (i) Tuition is below \$20,000 per year (ii) Student faculty ratio is below 25:1, (iii) Acceptance rate is above 40% (iv) PAL courses are offered in Engineering.
- 4) What type of gate would you use to: Compare two 1-bit binary numbers and produce a High ("1") output if the numbers are not equal. For example, if the 1-bit numbers are "1" and "0", then the output should be a "1".
- 5) What type of gate would you use to: Compare two 1-bit binary numbers and produce a Low ("0") output if the numbers are not equal. For example, if the 1-bit numbers are "1" and "0", then the output should be a "0".
- 6) Determine whether the following Boolean equation is true or false.

$$x'y' + x'z + x'z' = x'z' + y'z' + x'z$$

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Example 3) Implement AND Gate using NAND Gates only.



- 7) In the example 3 above, what is the output Y if you replace the NAND gate on the RIGHT with a NOR gate?
- 8) In the example 3 above, what is the output Y if you replace the NAND gate on the LEFT with a NOR gate?
- 9) Why are NAND and NOR gates called universal gates?
- 10) How can you implement a "OR" gate using "NOR" gates only?