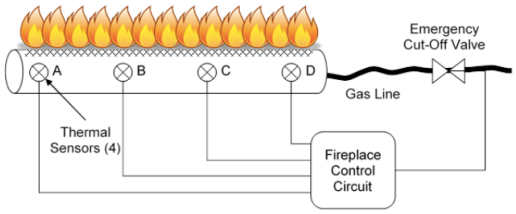
(40 pts) Approx. 3 days

The final part of the unit asks you to use what you've learned to design, simulate, and build a circuit to address the following situation… READ IT CAREFULLY! There is lots of information in there



The Acme Fireplace Company has hired you to redesign the fireplace control circuit for their latest residential gas fireplace. The fireplace burner is equipped with four thermal sensors that output a logic 1 whenever a flame is present. These sensors are connected to the fireplace control circuit, which outputs a 1 to the emergency cutoff valve to keep the gas flowing (a 0 will turn the gas off). The original design of the fireplace control circuit was quite simple. For the gas valve to remain on, all four sensors needed to output a logic 1. During field testing it was discovered that variations in gas pressure and humidity cause the thermal sensors to occasionally output a logic 0 even when a flame is present. This caused frequent unnecessary shut downs and constant customer dissatisfaction. For the redesign, the designers determined that the emergency cutoff value should remain open as long as three of the four sensors indicate that a flame is present. Additionally, the designers have asked you to add a second output indicator to the control circuit. This indicator will output a logic 1 when the four sensors do not all agree (not all on or not all off). This indicator will be used by the service technician to diagnose whether a faulty sensor exists. IN ADDITION: The circuit that controls the emergency cutoff valve must be implemented using only 74LS00 two-input NAND gates, and The circuit for the possible faulty sensor indicator must be implemented using only 74LS02 two-input NOR gates

1. Create a truth table of the "Fireplace Cutoff" situation.
2. Use your truth table to make an unsimplified logic expression.
3. Use K-Mapping to simplify your logic expression.
4. *HAVE MR. BENSHOOF CONFIRM YOUR SIMPLIFIED LOGIC EXPRESSION BEFORE CONTINUING!*
5. Create an AOI circuit of your simplified logic expression.
6. Replace part of your AOI circuit with NAND-only logic, and another part with NOR-only logic
7. Simulate your circuit in Multisim and confirm that it works as intended.
8. Build your circuit on your breadboard using the built-in switches and LEDs. Confirm that it works as intended.

Part 3: Tasks	*8-7 points*	*6-4 points*	*3-0 points*
Truth Table & Expression	+ Your truth table includes all necessary inputs/outputs + Your truth table is correct	- Your truth table is not correct	- Your truth table is missing
Simplify with K-Mapping	+You created an unsimplified logic expression + You showed your work to simplify your logic expression with K-Mapping	- One of your expressions is missing - You did not show your simplifying work	- Both your expressions are missing - Your expressions are wrong
NAND/NOR Circuits	+ Your circuit has the required NAND-only components + Your circuit has the required NOR-only components	- Your circuit does not use only 2-input gates - Your circuit is wrong	- Your circuit is missing
Multisim & Breadboarding	+ Your Multisim circuit works correctly	- Your Multisim circuit does not work correctly	- Your Multisim circuit is missing
Flow Chart & Notes	+ You took notes on your process and created a flow-chart of the circuit design process	- You took only brief notes - No flow chart	- No notes or flow chart

Achievement: Recreate your circuit (up through the Multisim simulation – no breadboarding) in which you make the emergency cutoff valve circuit with NOR-only, and the indicator with NAND-only logic