1.) For the following circuits, use a K-map to produce a simplified Sum-of-Products equation.

(a) \( F = (A \oplus B) \cdot \overline{C} + D \cdot (A \cdot \overline{B} + \overline{C} \cdot D) \)  Remember, \( \oplus = XOR \). Also, to evaluate complex equations you can use a truth table, and evaluate subfunctions first.

(b) \( G = \overline{A} (B \oplus C) + AB + AC\overline{B} \)

(c) \( H = \overline{A} \cdot \overline{B} \cdot C \cdot D + \overline{C} \cdot D \cdot (A + \overline{B}) + \overline{A} \cdot B \cdot (C + D) + A \cdot \overline{B} \cdot C \cdot D \)

2.) For the following K-Map, produce the simplified Sum-of-Products equation.

![K-Map Diagram]

3.) We wish to implement the following circuit:

A jet has 4 engines. Each engine gives a FAIL signal which is TRUE if the engine is broken, and is FALSE if the engine is working fine. The plane can fly as long as at most 1 engine is broken. We want a signal EMERGENCY, which is true if the plane can no longer fly.

(a) Using a K-Map, produce a simplified Sum-of-Products equation for this circuit.

(b) Draw the corresponding circuit diagram using as few gates as possible. All gates should be inverting (Inverter, NAND, NOR).

4.) A 4-input majority gate is a function that is TRUE when most of its inputs are TRUE, and FALSE when most of its inputs are FALSE. Ambiguous situations should be treated as “Don’t Cares”.

Using a K-Map, produce a simplified Sum-of-Products equation for this circuit. If there is more than one possible solution to the K-map, pick one.

(Note – continued on next page)
5.) For the circuit given below, show the output ("F") waveform for the transition \((A=0, B=1, C=0)\) to \((A=1, B=1, C=0)\). All gates (inverters, ANDs, ORs, XORs) have a delay of 5ns. The diagram shows the signal values from about 0ns on, but you can assume all inputs have been at their respective values for a long time before this chart (i.e. \(A\) is 0 at time 0ns, and -5ns, and -10ns, etc.).