

EE2000 - Tutorial 3

1. A burglar alarm is designed so that it senses four input signal lines. Line *A* is from the secret control switch, line *B* is from a pressure sensor under a steel safe in a locked closet, line *C* is from a battery-power lock, and line *D* is connected to a switch on the locked closet door. The following conditions produce a logic 1 voltage on each line.

A: The control switch is closed.

B: The safe is in its normal position in the closet.

C: The clock is between 10:00 and 14:00 hours.

D: The closet door is closed.

Write the switching expression for the burglar alarm that produces a logic 1 (rings a bell) when the safe is moved and the control switch is closed, or when the closet is opened after banking hours, or when the closet is opened with the control switch open.

2. Implement the following expression using 2-input NAND gates only (use DeMorgan's law).
 - (i) $ABC + DE$
 - (ii) $ABC + \overline{D} + E$
3. Design a combinational circuit for a 4-bit BCD-to-Gray code converter.
4. Design a logic circuit that converts a 4-bit number from signed-magnitude format to two's complement format. Use a two-level AND-OR circuit for each of four outputs.
5.
 - (a) Describe the overflow conditions as applied to two's complement addition and subtraction.
 - (b) Design an overflow detection circuit for 4-bit addition and subtraction, assuming that the unit is used to add and subtract number in a 4 bit two's complement number system.