Prelab – Experiment 11
Digital Logic Circuits

Read the lab instructions thoroughly and then answer the following questions:

1 Question 1

Derive and sketch logic circuits that carry out the operations (a)-(c) below using 2-input NAND gates only (see Figs. 1 and 2). DeMorgan's theorem may be useful. Try to use at most four NAND gates.

(a) 2-input OR gate: A OR $B = A + B$
(b) 2-input NOR gate: A NOR $B = \overline{A + B}$
(c) 2-input XOR gate: A XOR $B = A \oplus B$

The truth table for $A \oplus B$ (exclusive OR) is:

A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

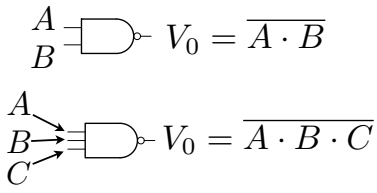

Figure 1: Two- and three-input NAND gates

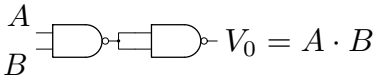

Figure 2: Example circuit for a 2-input AND operation using NAND gates only

2 Question 2

Derive and sketch logic circuits that carry out the operations for (a)-(d) below. Only use combinations of 2-input and 3-input NAND gates. (Hint: you need at most 5 gates)

(a) $(A \cdot B) + C$
(b) $((A \cdot B) + C) \cdot D$
(c) $(A \cdot B) + (C \cdot D)$
(d) $(A \cdot B \cdot C) + D + E$