



BLG 231E - Digital Circuits

Assignment 2

Due Date: Thursday, October 20, 2022, 23:59.

- Please prepare your homework using a computer. Points will be taken off for handwritten submissions.
- **Consequences of plagiarism:** Any cheating will be subject to disciplinary action.
- **No late submissions** will be accepted. **Do not send your solutions by e-mail.** We will only accept files that have been uploaded to the official Ninova e-learning system before the deadline. Do not risk leaving your submission to the last few minutes.
- **Submissions:** Submit your solution PDFs to Ninova. Please **write your full name** (first name and last name) **and Student ID** inside the box below.

Student ID :
Full Name :

If you have any questions, please e-mail teaching assistant
• Büşranur Bülbül Demir (bulbulb17@itu.edu.tr)

The truth table for the function $f(a,b,c,d)$ is given on the right:

- 1) [30 pts] Write the expressions for $f(a,b,c,d)$ in
- the first canonical form
 - the second canonical forms

CONVENTIONS:

- Write the literals in the terms in alphabetical order.
 $ab'c$ (**not** acb')
- Write the expression starting with the term that has the fewest literals, and then proceeding in ascending order of literals per term, such as:
 $ab + abd + abcde$

- 2) [20 pts] Convert the second canonical form expression to first canonical form expression using axioms and theorems of Boolean algebra.
- 3) [30 pts] Minimize the expression for $f(a,b,c,d)$ in the first canonical form using axioms and theorems of Boolean algebra. Show all steps in your minimization and write the name of the axiom/theorem/property you use on the right-hand side of the expression at each step.
- 4) [20 pts] Draw the circuit for the minimized expression you found in Question 3 above using
- 2-input NAND gates only.

Show all steps, and explain your work leading up to the final circuit.

a	b	c	d	f
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1