

## ENGR121 Assignment 2

DUE: 11:59pm Wednesday 20 March 2024

Submission is online via the Submission link in Nuku. Ensure your submission is a single pdf file, with a name that ends with the characters *yourUserName.pdf*. It's a good idea to view your submission after uploading it to check you submitted the right file, etc.

1. Find the inverses of the following functions:

(a)  $f(x) = x + 3$

(b)  $g(t) = 5 - 4t$

(c)  $y(x) = (2x)^4$

(d)  $h(t) = \frac{2t-3}{7}$

2. Given that  $f(t) = 4t$ ,  $g(t) = 3t + 2$ , and  $h(t) = t^3$ , write down expressions for the composite functions

(a)  $f(g(t))$

(b)  $f(g(x))$

(c)  $f(h(t))$

(d)  $f(g(h(t)))$

(e)  $f(f(y))$

3. Sketch the function

$$f(t) = \begin{cases} 4 - 2t & , \quad 0 \leq t < 2 \\ t + 2 & , \quad 2 \leq t \leq 5 \end{cases}$$

- (a) Is  $f$  continuous, or piecewise continuous?

- (b) Where are the discontinuities in  $f$ , if any?

- (c) What is the range of  $f$ ?

4. (Croft Ex 2.3 p. 65)

The function  $h(t)$  is defined as

$$h(t) = \begin{cases} t + 2 & , \quad 0 \leq t < 2 \\ 4 & , \quad 2 \leq t < 4 \end{cases}$$

and  $h$  has period 4. Sketch  $h$  on the domain  $[-4, 8]$ . Does  $h$  have any discontinuities? If so, where are they?

5. (Croft Ex 1.6 p.37)

Find the sets of real numbers that satisfy the inequalities:

(a)  $-3x < 3$

(b)  $3w + 6 \geq 9$

(c)  $\frac{4+2w}{5} < 4$

(d)  $(2x + 1)^2 \leq 16$

6. Consider the Boolean expression  $A \cdot \overline{B} + \overline{B} \cdot \overline{C}$

- (a) Draw the corresponding logic circuit.

- (b) Write a truth table for the expression.

7. Simplify, showing all working:

(a)  $(A \cdot 1) + \overline{A}$

(b)  $\overline{A + 1}$

(c)  $(A + A) \cdot (B + \overline{B})$

(d)  $(A + B) + (C \cdot \overline{B}) + (C \cdot B)$

8. (Croft Ex 5.4, page 185)

The truth table for the Boolean expression  $X$  is given below. Write  $X$  in disjunctive normal form, simplify it as much as possible, and sketch a logic circuit that will deliver the same output.

$A$	$B$	$C$	$X$
1	1	1	1
1	1	0	1
1	0	1	0
1	0	0	0
0	1	1	1
0	1	0	1
0	0	1	1
0	0	0	1

## Tutorial Questions for Assignment 2, ENGR121

Note that tutorial questions often mirror the assignment questions, so doing the tutorial questions will help you do the assignment.

1. Find the inverses of the following functions:

(a)  $f(x) = x + 7$

(b)  $g(t) = 3t - 2$

(c)  $y(x) = x^5$

(d)  $h(t) = \frac{6t-4}{2}$

2. Given that  $f(t) = t - 1$ ,  $g(t) = 4t$ , and  $h(t) = t^2$ , write down expressions for the composite functions

(a)  $f(g(t))$

(b)  $g(f(t))$

(c)  $f(h(t))$

(d)  $g(f(h(x)))$

(e)  $g(g(y))$

3. Sketch the function

$$f(t) = \begin{cases} 2t & , \quad 0 \leq t < 2 \\ t - 2 & , \quad 2 \leq t < 3 \end{cases}$$

- (a) Is  $f$  continuous?

- (b) Is  $f$  piecewise continuous?

- (c) Where are the discontinuities in  $f$ , if any?

- (d) What is the domain of  $f$ ?

- (e) What is the range of  $f$ ?

4. (Croft Ex 2.3 p. 65)

The function  $g(t)$  is defined as

$$g(t) = \begin{cases} 1 & , \quad 0 \leq t \leq 1 \\ 2 - t & , \quad 1 < t < 2 \end{cases}$$

and  $g$  has period 2. Sketch  $g$  on  $[-1, 4]$ . State where the discontinuities of  $g$  are, if any.

5. (Croft Ex 1.6 p.37)

Find the sets of real numbers that satisfy the inequalities:

(a)  $\frac{x}{2} > 1$

(b)  $t + 3 < 5$

(c)  $\frac{(t+1)}{2} > 1$

(d)  $(x - 1)^2 < -1$

(e)  $(v - 2)^2 \geq 16$

6. For the Boolean expression

$$A + \overline{(B + C)}$$

- (a) Construct a truth table

- (b) Design electronic circuit that produces the same output

7. Simplify, showing all working:

(a)  $A \cdot A \cdot \overline{A}$

(b)  $(A + A) \cdot (\overline{A} + A)$

(c)  $\overline{A + 1}$

(d)  $(A + A) \cdot (A + C)$

(e)  $A \cdot (A + C) + C \cdot B + D + C + B \cdot \overline{C} + C \cdot A$

8. Express the following using only conjunction and negation:

$$A \cdot \overline{B} + \overline{A} \cdot B$$

9. (Croft Ex 5.4, page 185)

The truth table for the Boolean expression  $X$  is given below. Write  $X$  in disjunctive normal form, simplify it as much as possible, and sketch a logic circuit that will deliver the same output.

$A$	$B$	$C$	$X$
1	1	1	0
1	1	0	1
1	0	1	1
1	0	0	0
0	1	1	1
0	1	0	0
0	0	1	0
0	0	0	0