

# Homework 4

Max marks: 40

Due on Oct 1st, 2021, 9 AM, before class.

**Problem 1** Hazard problem: Design a hazard free SOP for  $f(A, B, C, D) = \sum m(0, 1, 4, 5, 6, 7, 9, 11, 14, 15)$

**Solution**

The K-map for  $f$  is

		$\bar{A}$		$A$	
		$\bar{B}$	$B$	$\bar{B}$	$B$
$\bar{C}$	$\bar{D}$	1	1	0	0
	$D$	1	1	0	1
$C$	$\bar{D}$	0	1	1	1
	$D$	0	1	1	0

$$f = \bar{A}B + BC + ACD + \bar{A}\bar{C} + \bar{A}BD + \bar{B}\bar{C}D$$

**Problem 2** Find the simplest realization of the function  $f(x_1, \dots, x_4) = \sum m(0, 3, 4, 7, 9, 10, 13, 14)$ , assuming that the logic gates have a maximum fan-in of two.

**Problem 3** Find the minimum-cost circuit for the function  $f(x_1, \dots, x_4) = \sum m(0, 4, 8, 13, 14, 15)$ . Assume that the input variables are available in uncomplemented form only. (Hint: Use functional decomposition.)

**Problem 4** Use functional decomposition to find the best implementation of the function  $f(x_1, \dots, x_5) = \sum m(1, 2, 7, 9, 10, 18, 19, 25, 31) + D(0, 15, 20, 26)$ . How does your implementation compare with the lowest-cost SOP implementation? Give the costs.