Istanbul Technical University

BLG 231E - Digital Circuits
Assignment 3
Solution Key

1. a.

Useless because it does not cover any of 1-generating combinations of the function.

f \ c,d a,b	00	01	11	10
00		Φ		1
01		Φ		1
11	1		1	1
10	1	1	1	1

set of <u>all prime implicants</u> in <u>SOP</u> form: **ac + cd' + ab' + ad' + b'c'd**

1. b.

Implicants (Order 0):

	a	b	c	d	
1:	0	0	0	1	→
2:	0	0	1	0	→
5:	0	1	0	1	→
6:	0	1	1	0	→
8:	1	0	0	0	→
9:	1	0	0	1	→
10:	1	0	1	0	→
11:	1	0	1	1	→
12:	1	1	0	0	→
14:	1	1	1	0	→
15:	1	1	1	1	→

Implicants (Order 1):

	a	b	c	d	
1, 5:	0	-	0	1	(×)
1, 9:	-	0	0	1	✓
2, 6:	0	-	1	0	→
2, 10:	-	0	1	0	→
6, 14:	-	1	1	0	→
8, 9:	1	0	0	-	→
8, 10:	1	0	-	0	→
8, 12:	1	-	0	0	→
9, 11:	1	0	-	1	→
10, 11:	1	0	1	-	→
10, 14:	1	-	1	0	→
11, 15:	1	-	1	1	→
12, 14:	1	1	-	0	→
14, 15:	1	1	1	-	→

Implicants (Order 2):

	a	b	c	d	
2, 6, 10, 14:	-	-	1	0	✓
8, 9, 10, 11:	1	0	-	-	✓
8, 10, 12, 14:	1	-	-	0	✓
10, 11, 14, 15:	1	-	1	-	✓

set of <u>all prime implicants</u> in <u>SOP</u> form = ac + cd' + ab' + ad' + b'c'd

2.

Prime Implicant Chart:

		2	6	8	9	10	11	12	14	15	COST
2,6,10,14	cd'	X	X			X			X		5
8,9,10,11	ab'			X	X	X	X				5
8,10,12,14	ad'			X		X		X	X		5
10,11,14,15	ac					X	X		X	X	4
1,9	b'c'd				X						8

			2	6	8	9	10	11	12	14	15	COST
√	2,6,10,14	cd'	X	X			X			X		5
	8,9,10,11	ab'			X	X	X	X				5
	8,10,12,14	ad'			X		X		X	X		5
√	10,11,14,15	ac					X	X		X	X	4
	1,9	b'c'd				X						8

Extracted essential prime implicants: cd', ac

			8	9	12	COST
	8,9,10,11	ab'	X	X		5
√	8,10,12,14	ad'	X		X	5
	1,9	b'c'd		X		8

Extracted essential prime implicant: ad'

			9	COST
√	8,9,10,11	ab'	X	5
	1,9	b'c'd	X	8

Select the one with the lower cost

Extracted essential prime implicants: ab'

expression for the function with the lowest cost: ac + cd' + ab' + ad'

total cost: 19