Chapter 8.1: Logic Coverage Criteria

Complete the problems below and submit this word document with your answers.

What to do? Choose any 2 predicates below and answer the following questions for each of them.	**Extra Credit:** This is optional. You will receive up to 20 points for this part. Choose a predicate below and answer the following questions for this predicate.
1) p = a ∧ (b ∨ ¬c) 2) p = a ∨ (¬b ∧ c) 3) p = a ∨(b ∧ ¬c) ∨¬c 4) p = (a ∧ ¬b) ∨ (b ∧ ¬c) ∨ (a ∧ ¬c)	5) p = (a ∨ b) ∧ (c ∨ ¬d) 6) p = (a ∧ b) ∨ (¬a ∧ c) ∨ (a ∧ ¬c) 7) p = a ∨ b ∨ (c ∧¬d)

a. List the clauses that go with predicate `p`.
b. Compute (and simplify) the conditions under which each clause determines predicate `p`. Be sure to include details or steps showing how you compute and simplify.
c. Write the complete truth table for all clauses. Label your rows starting from 1.
   Use the format in the examples we covered in lecture. That is, row 1 should be all clauses true. You should include columns for the conditions under which each clause determines the predicate, and also a column for the value of the predicate itself.
d. Give a list of pairs of rows from your table that satisfy `Clause Coverage (CC)` but does not satisfy `Predicate Coverage (PC)`
e. List all pairs of rows from your table that satisfy `General Active Clause Coverage (GACC)` with respect to each clause.
f. List all pairs of rows from your table that satisfy `Correlated Active Clause Coverage (CACC)` with respect to each clause.
g. List all pairs of rows from your table that satisfy `Restricted Active Clause Coverage (RACC)` with respect to each clause.
h. List all 4-tuples of rows from your table that satisfy `General Inactive Clause Coverage (GICC)` with respect to each clause. List any infeasible `GICC` test requirements.
i. List all 4-tuples of rows from your table that satisfy `Restricted Inactive Clause Coverage (RICC)` with respect to each clause. List any infeasible `RICC` test requirements.

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Homework - 5

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① $P = a \wedge (b \vee \neg c)$

a) clauses → a, b, c

b) → P_a = P_a = true ⊕ P_a = false

$= (\text{true} \wedge (b \vee \neg c)) \oplus (\text{false} \wedge (b \vee \neg c))$

$= (b \vee \neg c) \oplus \text{false}$

$\therefore \boxed{P_a = b \vee \neg c}$ (Using XOR identity laws)

→ P_b = P_b = true ⊕ P_b = false

$= (a \wedge (\text{true} \vee \neg c)) \oplus (a \wedge (\text{false} \vee \neg c))$

$= (a \wedge \text{true}) \oplus (a \wedge \neg c)$

$= a \oplus (a \wedge \neg c)$

$\therefore \boxed{P_b = a \wedge c}$ (Using XOR identity rules)

→ P_c = P_c = true ⊕ P_c = false

$= (a \wedge (b \vee \text{false})) \oplus (a \wedge (b \vee \text{true}))$

$= (a \wedge b) \oplus (a \wedge \text{true})$

$= (a \wedge b) \oplus a$

$\therefore \boxed{P_c = a \wedge \neg b}$ (Using XOR identity rules)

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c)

Blank cells represent values of 'F'.

	a	b	c	p	Pa	Pb	Pc
1	T	T	T	T	T	T	
2	T	T	F	T	T		
3	T	F	T	F		T	T
4	T	F	F	T	T		T
5	F	T	T	F	T		
6	F	T	F	F	T		
7	F	F	T	F			
8	F	F	F	F	T		

d) cc but not pc

(3, 6)

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e) GACC

Clause a → {1, 2, 4} × {5, 6, 8}

→ (1,5), (1,6), (1,8), (2,5), (2,6), (2,8), (4,5), (4,6), (4,8)

Clause b → (1,3)

Clause c → (3,4)

f) CACC pairs for clauses a, b and c are same as GACC pairs

g) RACC

Clause a → (1,5), (2,6), (4,8)

clause b → (1,3)

clause c → (3,4)

h) GICC

Clause a →

P = T , Pa = F

a = T rows

a = F rows

P = F , Pa = F

a = T rows 3

a = F rows 7

No feasible pairs for P = T

(3,7) for P = F

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Clause b → $p=T$, $p_b=F$

$b=T$ rows 2

$b=F$ rows 4

$p=F$, $p_b=F$

$b=T$ rows 5, 6 $\{5,6\} \times \{7,8\}$

$b=F$ rows 7, 8

(2,4) for $p=T$; (5,7), (5,8), (6,7), (6,8) for $p=F$

Clause c → $p=T$, $p_c=F$

$C=T$ rows 1

$C=F$ rows 2

$p=F$, $p_c=F$

$C=T$ rows 5, 7 $\{5,7\} \times \{6,8\}$

$C=F$ rows 6, 8

1 2

(1,2) for $p=T$; (5,6), (5,8), (7,6), (7,8) for $p=F$

i) RICC

Clause a → same as CICC

Clause b → (2,4) for $p=T$; (5,7), (6,8) for $p=F$

Clause c → (1,2) for $p=T$; (5,6), (7,8) for $p=F$

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(2) $P = a \vee (\neg b \wedge c)$

a) clauses → a, b, c

b) → $P_a = P_{a=true} \oplus P_{a=false}$

$= (true \vee (\neg b \wedge c)) \oplus (false \vee (\neg b \wedge c))$

$= true \oplus (\neg b \wedge c)$

$= \neg(\neg b \wedge c)$ (using XOR identity laws)

$\therefore \boxed{P_a = b \vee \neg c}$

→ $P_b = P_{b=true} \oplus P_{b=false}$

$= (a \vee (false \wedge c)) \oplus (a \vee (true \wedge c))$

$= (a \vee false) \oplus (a \vee c)$

$= a \oplus (a \vee c)$ (using XOR identity rules)

$\therefore \boxed{P_b = \neg a \wedge c}$

→ $P_c = P_{c=true} \oplus P_{c=false}$

$= (a \vee (\neg b \wedge true)) \oplus (a \vee (\neg b \wedge false))$

$= (a \vee \neg b) \oplus (a \vee false)$

$= (a \vee \neg b) \oplus a$ (using XOR identity rules)

$\therefore \boxed{P_c = \neg a \wedge \neg b}$

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c)

	a	b	c	P	Pa	Pb	Pc
1	T	T	T	T	T		
2	T	T	F	T	T		
3	T	F	T	T			
4	T	F	F	T	T		
5	F	T	T	F	T	T	
6	F	T	F	F	T		
7	F	F	T	T		T	T
8	F	F	F	F	T		T

Blank cells represent value of 'F'

d) (2,7) → CC but not PC

e) GACC

clause a → {1,2,4} x {5,6,8}

→ (1,5), (1,6), (1,8), (2,5), (2,6), (2,8), (4,5), (4,6), (4,8)

clause b → (5,7)

clause c → (7,8)

f) CACC pairs for clauses a, b and c are same as GACC pairs.

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g) RACC

Clause a → (1,5), (2,6), (4,8)

Clause b → (5,7)

Clause c → (7,8)

h) GICC

Clause a → $p = T$, $pa = F$

$a = T$ rows 3

$a = F$ rows 7

$p = F$, $pa = F$

$a = T$ rows

$a = F$ rows

(3,7) for $p = T$

No feasible pairs for $p = F$

Clause b → $p = T$, $pb = F$

$b = T$ rows 1, 2 $\{1,2\} \times \{3,4\}$

$b = F$ rows 3, 4

$p = F$, $pb = F$

$b = T$ rows 6

$b = F$ rows 8

(1,3), (1,4), (2,3), (2,4) for $p = T$

(6,8) for $p = F$

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clause c → $p = T$, $p_c = F$

$c = T$ rows 1, 3 {1, 3} ✗

$c = F$ rows 2, 4 {2, 4}

$p = F$, $p_c = F$

$c = T$ rows 5

$c = F$ rows 6

(1, 2), (1, 4), (3, 2), (3, 4) for $p = T$

(5, 6) for $p = F$

i) RICC

clause a → Same as CICC

clause b → (1, 3), (2, 4) for $p = T$

(6, 8) for $p = F$

clause c → (1, 2), (3, 4) for $p = T$

(5, 6) for $p = F$

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(7) $p = a \vee b \vee (c \wedge \neg d)$

a) clauses → a, b, c, d

b) p_a = $p_a = true \oplus p_a = false$

$= (true \vee b \vee (c \wedge \neg d)) \oplus$
$(false \vee b \vee (c \wedge \neg d))$

$= true \oplus (b \vee (c \wedge \neg d))$

$\therefore \boxed{p_a = \neg b \wedge (\neg c \vee d)}$

→ p_b = $p_b = true \oplus p_b = false$

$= (a \vee true \vee (c \wedge \neg d)) \oplus$
$(a \vee false \vee (c \wedge \neg d))$

$= true \oplus (a \vee (c \wedge \neg d))$

$\therefore \boxed{p_b = \neg a \wedge (\neg c \vee d)}$

→ p_c = $p_c = true \oplus p_c = false$

$= (a \vee b \vee (true \wedge \neg d)) \oplus$
$(a \vee b \vee (false \wedge \neg d))$

$= (a \vee b \vee \neg d) \oplus (a \vee b)$

$= (\neg a \wedge \neg b) \wedge \neg d$

$\therefore \boxed{p_c = \neg a \wedge \neg b \wedge \neg d}$

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→ P_d = $P_{d=true} \oplus P_{d=false}$

$= (a \vee b \vee (c \wedge false)) \oplus (a \vee b \vee (c \wedge true))$

$= (a \vee b) \oplus (a \vee b \vee c)$

$\therefore \boxed{P_d = \neg a \wedge \neg b \wedge c}$

c)

	a	b	c	d	P	P_a	P_b	P_c	P_d
1	T	T	T	T	T				
2	T	T	T		T				
3	T	T		T	T				
4	T	T			T				
5	T		T	T	T	T			
6	T		T		T				
7	T			T	T	T			
8	T				T	T			
9		T	T	T	T		T		
10		T	T		T				
11		T		T	T		T		
12		T			T		T		
13			T	T		T	T		T
14			T		T			T	T
15				T		T	T		
16						T	T	T	

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d) (8,9), (3,14), (5,12), (6,11), (7,10)
satisfy CC but not PC.

e) GACC

clause a → {5,7,8} × {13,15,16}
(5,13), (5,15), (5,16), (7,13),
(7,15), (7,16), (8,13), (8,15),
(8,16)

clause b → {9,11,12} × {13,15,16}
(9,13), (9,15), (9,16), (11,13),
(11,15), (11,16), (12,13), (12,15),
(12,16)

clause c → (14,16)

clause d → (13,14)

f) CACC pairs for clauses a, b, c and d are the same as GACC pairs

g) RACC

clause a → (5,13), (7,15), (8,16)

clause b → (9,13), (11,15), (12,16)

clause c → (14,16)

clause d → (13,14)

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h) GICC

Clause a → $p = T$, $p_a = F$

$a = T$ rows 1, 2, 3, 4, 6

$a = F$ rows 9, 10, 11, 12, 14

$p = F$, $p_a = F$

$a = T$ rows

$a = F$ rows

(1,9), (1,10), (1,11), (1,12), (1,14), (2,9), (2,10), (2,11), (2,12), (2,14), (3,9), (3,10), (3,11), (3,12), (3,14), (4,9), (4,10), (4,11), (4,12), (4,14), (6,9), (6,10), (6,11), (6,12), (6,14),

For $p = T$;

No feasible pairs for $p = F$.

Clause b → $p = T$, $p_b = F$

$b = T$ rows 1, 2, 3, 4, 10

$b = F$ rows 5, 6, 7, 8, 14

$p = F$, $p_b = F$

$b = T$ rows

$b = F$ rows

No feasible pairs for $p = F$;

(1,5), (1,6), (1,7), (1,8), (1,14), (2,5), (2,6), (2,7), (2,8), (2,14), (3,5), (3,6), (3,7), (3,8), (3,14), (4,5), (4,6), (4,7), (4,8), (4,14), (10,5), (10,6), (10,7), (10,8), (10,14) for $p = T$.

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Clause c → P=T, Pc=F

C=T rows 1,2,5,6,9,10

C=F rows 3,4,7,8,11,12

P=F, Pc=F

C=T rows 13

C=F rows 15

(13,15) for P=F;

{1,2,5,6,9,10} X {3,4,7,8,11,12} for P=T

Clause d → P=T, Pd=F

d=T rows 1,3,5,7,9,11

d=F rows 2,4,6,8,10,12

P=F, Pd=F

d=T rows 15

d=F rows 16

(15,16) for P=F;

{1,3,5,7,9,11} X {2,4,6,8,10,12} for P=T

i) RICC

Clause a → No feasible pairs for P=F;

(1,9), (2,10), (3,11), (4,12), (6,14) for P=T

Clause b → No feasible pairs for P=F;

(1,5), (2,6), (3,7), (4,8), (10,14) for P=T

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clause c → (1,3), (2,4), (5,7), (6,8), (9,11), (10,12) for p = T ;
(13,15) for p = F

clause d → (1,2), (3,4), (5,6), (7,8), (9,10), (11,12) for p = T ;
(15,16) for p = F

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