

# LSP 精选例题集 2015 版 (捷克语)

## 版本信息

- 版本: 2015-V1.1
  - 构建日期: 2016 年 1 月 6 日
  - 语言: 捷克语
  - 内容: 往年考试精选例题, 附详细解答
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## 说明

- 例题来自往年考试, 用于展示考试内容
  - 不是完整列表, 考试可能出现其他题目
  - 不包含理论问答题
  - 没有解答的题目可以通过仿真或讲座验证
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## B 系列例题

### B1. De Morgan 展开 (XOR 转 AND/OR/NOT)

题目: 将 VHDL 函数展开, 使其只包含“or”、“and”和“not”操作, 且“not”不能作用于括号内的表达式。[English] Expand the VHDL function so it only contains “or”, “and” and “not” operations, where “not” cannot apply to expressions in parentheses.

F1 <= A xor (B or C);

答案:

F1 <= (A and not B and not C) or (not A and (B or C));

F2 <= not (A and (B xor C));

答案:

F2 <= not A or ((not B or C) and (B or not C));

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### B3. RS 锁存器仿真

输入序列:

A = 0|1|1|1  
B = 0|0|0|1  
C = 1|1|0|0  
t0|t1|t2|t3

答案:

Q = 1|0|0|1

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### B4. Shannon 展开

题目: 将 B3 的函数  $Q=f(A,B,C,Q)$  分解为  $Q = Q \cdot f(A,B,C) + \bar{Q} \cdot f(A,B,C)$  [English] Decompose the function  $Q=f(A,B,C,Q)$  from B3 into  $Q = Q \cdot f(A,B,C) + \bar{Q} \cdot f(A,B,C)$

解法步骤: 1. 从电路图写出表达式:  $Q := (A \text{ xor } B) + (Q + (B \text{ xor } C))$  2. 用 De Morgan 展开:  $Q := (A \cdot B) \cdot (Q + (B \cdot C))$  3. 计算 cofactors:  $-f = f(A,B,C,0) = (A \cdot B) \cdot (B \cdot C) - f = f(A,B,C,1) = (A \cdot B)$

答案 (卡诺图):

f0:	A				f1:	A			
	B 0 1					B 0 1			
C 0	0	0	1	0	1	0	1	0	
1	1	0	0	0	1	0	1	0	

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## B5. 卡诺图覆盖 (SoP 和 PoS)

题目: 标记最小覆盖, 选择不产生 hazard 的覆盖 [English] Mark the minimum cover, choose covers that do not produce hazards

要点: - SoP 覆盖 1 - PoS 覆盖 0 - 需要连续覆盖以避免 hazard

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## A 系列例题

### A1. 逻辑函数取反

题目: 写出函数的非否定形式 [English] Write the function in non-negated form

$$F1 = A \cdot B \cdot C + A \cdot B \cdot C + A \cdot B + A \cdot C + B \cdot C$$

答案:

$$F1 = (A+B+C) \cdot (A+B+C) \cdot (A+B) \cdot (A+C) \cdot (B+C)$$

$$F2 = (A+B+C) \cdot (A+B+C) \cdot (A+B) \cdot (A+C) \cdot (B+C)$$

答案:

$$F2 = A \cdot B \cdot C + A \cdot B \cdot C + A \cdot B + A \cdot C + B \cdot C$$


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### A3. 组合电路输出计算

输入:  $A=0, B=1, C=0, D=0$

答案: -  $X = 1 - Y = 0 - Z = 1$

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### A4. Shannon 展开 (4 变量)

题目:  $Y=f(A,B,C,D)$  分解为  $Y = C \cdot f(A,B,D) + C' \cdot f(A,B,D)$  [English] Decompose  $Y=f(A,B,C,D)$  into  $Y = C \cdot f(A,B,D) + C' \cdot f(A,B,D)$

答案 (卡诺图):

f0:	A				f1:	A			
	B 0 1					B 0 1			
D 0	1	0	0	1	0	1	1	0	
1	1	0	0	1	1	1	1	1	

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## C 系列例题

### C1. 基本门真值表

门类型	符号	真值表
NAND		00→1, 01→1, 10→1, 11→0
NOR		00→1, 01→0, 10→0, 11→0
AND		00→0, 01→0, 10→0, 11→1
XOR		00→0, 01→1, 10→1, 11→0

## D 系列例题

### D3. 四变量 Shannon 展开

题目:  $Q = (A \text{ or } B) \text{ and } (((A \text{ and not } B) \text{ xor } (D \text{ and not } A)) \text{ or } (C \text{ and not } D))$  分解为  $Q = CD \cdot f + CD \cdot f + CD \cdot f + CD \cdot f$  [English] Decompose  $Q = (A \text{ or } B) \text{ and } (((A \text{ and not } B) \text{ xor } (D \text{ and not } A)) \text{ or } (C \text{ and not } D))$  into  $Q = CD \cdot f + CD \cdot f + CD \cdot f + CD \cdot f$

答案 (卡诺图):

f0:	A	f1:	A	f2:	A	f3:	A
	B 0 1		B 0 1		B 0 1		B 0 1
	0 1		0 1		0 1		0 1
	0 0		1 0		1 1		1 0

### D4. 等价逻辑函数

```
f1 <= (A xor C) or (A and not C);
f2 <= (B or C) and (not A or B or C);
f3 <= ((C and not B) or (B and A));
f4 <= (A or C) and (not A or not C);
f5 <= (A and not B) xor (A and C);
f6 <= (A and not C) or (C and not A);
```

答案: f4 f6 (都是 A XOR C)

## E 系列例题

### E1. 6 输入比较器电路

题目: 写出 YZ 的真值表 [English] Write the truth table for YZ

功能分析: - 这是一个 3 位比较器 - Y:  $FDB > ECA$  (大于) - Z:  $FDB = ECA$  (相等)

### E4. 等价逻辑函数

```
f1 <= ((C and not B) or (C and B and A));
f2 <= (A xor C) or (A and not C);
f3 <= (A or B) and (not A or B or C);
f4 <= (not A or not C) and (C or A);
```

```
f5 <= (not C and A) or (not A and C);
f6 <= (A and not B) xor (A and not B and C);
```

答案: f4 f5 (都是 A XOR C)

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#### E4x. XOR 等价判断

题目: 判断以下函数是否相同 [English] Determine if the following functions are equivalent

```
x1 <= (A and not C) or (C and not A);
x2 <= (A and not B) xor (A and C);
x3 <= (A or C) and (not A or not C);
x4 <= (A xor C) or (A and not C);
```

答案: - x1 x3 (标准 XOR 的 SoP 和 PoS 形式) - x4 = A or C (x4 不等于 x1) - x2 需要用卡诺图分析

解法关键: - x1 和 x3 可以直接画卡诺图 (分别是 SoP 和 PoS 形式) - 结果都是 A XOR C 的标准形式

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#### C4. 四变量等价函数

```
f1 <= (((not B and not A) or (A and D)) and C) or (B and A);
f2 <= (((not A or D) and C) or A) and B;
f3 <= ((C and (not A or D)) or B) and A and not B;
f4 <= ((not A or D) and C and not B) or (B and A);
f5 <= (A and not B) or (A and D) or (B and A);
f6 <= (B or C) and (not A or B or D) and (A or not B);
```

答案: f1 f4

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#### 考试要点总结

##### 1. De Morgan 定律

$\text{NOT}(A \text{ AND } B) = (\text{NOT } A) \text{ OR } (\text{NOT } B)$   
 $\text{NOT}(A \text{ OR } B) = (\text{NOT } A) \text{ AND } (\text{NOT } B)$   
 $A \text{ XOR } B = (A \text{ AND NOT } B) \text{ OR } (\text{NOT } A \text{ AND } B)$

##### 2. XOR 的两种标准形式

- SoP (Sum of Products):  $(A \text{ and not } B) \text{ or } (\text{not } A \text{ and } B)$
- PoS (Product of Sums):  $(A \text{ or } B) \text{ and } (\text{not } A \text{ or not } B)$

##### 3. Shannon 展开

- $f(X) = X \cdot f + X \cdot f$
- $f = f(X=0)$
- $f = f(X=1)$

##### 4. 卡诺图覆盖

- SoP: 覆盖所有 1
- PoS: 覆盖所有 0
- 避免 hazard: 使用连续覆盖