(4) $F=\overline{AC+\overline{A}BC+\overline{B}C+A\,\overline{B}\,\overline{C}}$

$F = (\overline{AC} + \overline{A}BC)\cdot \overline{\overline{B}C}\cdot\overline{A\overline{B}\overline{C}}$

$= (\overline{AC} + \overline{A}BC)(B+\overline{C})(\overline{A}+\overline{B}+C)$

$= (AB\overline{C} + \overline{A}BC)(\overline{A}+\overline{B}+C)$

$= AB\overline{C} + \overline{A}BC$

$= BC$

(2) $F(A,B,C,D)=\overline{\overline{A}\,\overline{B}+ABD(B+\overline{C}D)}$

$F(A,B,C,D) = \overline{\overline{A}\,\overline{B}}\cdot\overline{ABD}\cdot(B+\overline{C}D)$

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

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

$= A\overline{B}\,\overline{C}D + AB\overline{D} + \overline{A}B + \overline{A}B\overline{C}D + B\overline{D}$

$= A\overline{B}\,\overline{C}D + B\overline{D} + \overline{A}B$

$= A\overline{B}\,\overline{C}D + B\overline{D} + \overline{A}B$

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

$= A\overline{B}\overline{C}D + ABC\overline{D} + \overline{A}BC\overline{D} + AB\overline{C}\overline{D} + \overline{A}B\overline{C}\overline{D}$
$+ \overline{A}BCD + \overline{A}BC\overline{D} + \overline{A}B\overline{C}D + \overline{A}B\overline{C}\overline{D}$

$= A\overline{B}\overline{C}D + ABC\overline{D} + \overline{A}BC\overline{D} + AB\overline{C}\overline{D} + \overline{A}B\overline{C}\overline{D}$
$+ \overline{A}BCD + \overline{A}B\overline{C}D = \sum m(4,5,6,7,9,12,14)$

(4) $F(A,B,C,D)=\sum m(0,13,14,15)+\sum \varphi(1,2,3,9,10,11)$

令无关项为 1

则 $F(A,B,C,D)$
$= \overline{A}\,\overline{B} + AD + AC$

(3) $F(A,B,C,D)=\sum \overset{\cdot}{m}(0,1,2,4,6,10,14,15)$

卡诺图化简

原 $= \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{D}$
$+ C\overline{D} + ABC$

$= \overline{\overline{\overline{A}\,\overline{B}\,\overline{C}}\cdot\overline{\overline{A}\,\overline{D}}\cdot\overline{C\overline{D}}\cdot\overline{ABC}}$

逻辑图

verilog

```
module booktest1103(input iA,
                    input iB,
                    input iC,
                    input iD,
                    output oF);
    assign oF = !iA & !iB & !iC |
                !iA & !iD |
                iC & !iD |
                iA & iB & iC;
endmodule
```
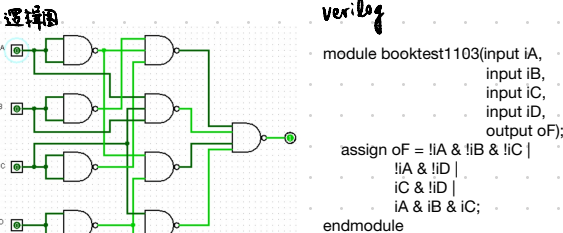
真值表

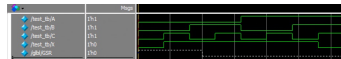| A	B	C	$A\bar{B}$	$B\bar{C}$	$\bar{A}C$	X
0	0	0	0	0	0	0
0	0	1	0	0	1	1
0	1	0	0	1	0	1
0	1	1	0	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	1
1	1	0	0	1	0	1
1	1	1	0	0	0	0

卡诺图

逻辑图
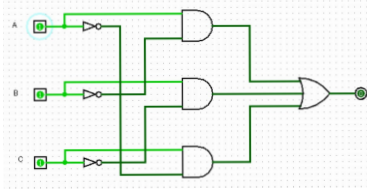
波形图

verilog

```
`timescale 1ns / 1ps
module bookTest12(
    input A,
    input B,
    input C,
    output X
    );

    assign X = A & !B | B & !C | C & !A;

endmodule
```

testbench

```
`timescale 1ns / 1ps
module test_tb(

    );
    reg A;
    reg B;
    reg C;
    wire X;

    bookTest12
bk(.A(A), .B(B), .C(C), .X(X))
;

    initial
    begin

      A = 0;
      #40 A = 0;
      #40 A = 0;
      #40 A = 0;
      #40 A = 1;
      #40 A = 1;
      #40 A = 1;
      #40 A = 1;

    end

    initial
    begin

      B = 0;
      #40 B = 0;
      #40 B = 1;
      #40 B = 1;
      #40 B = 0;
      #40 B = 0;
      #40 B = 1;
      #40 B = 1;

    end

    initial
    begin

      C = 0;
      #40 C = 1;
      #40 C = 0;
      #40 C = 1;
      #40 C = 0;
      #40 C = 1;
      #40 C = 0;
      #40 C = 1;

    end
endmodule
```
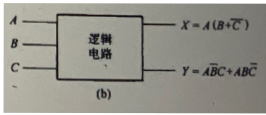
(b)

$$X = A(B + \overline{C})$$
$$Y = \overline{A}\overline{B}C + AB\overline{C}$$

$$X = A(B + \overline{C})$$
$$Y = A(\overline{B}C + B\overline{C})$$