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LAB SECTION: 11
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# HOMEWORK 3

P1. A. assign F = (A & B)

B. assign F = (A | B)

C. assign F = (A | B ) & (~A | ~B)

~~D. assign F = (~A | ~B | ~C) | (~A & (~B | ~C))~~

D. assign F = (~(A & B & C)) | (~A & ~(B & C))

P2. A. ~~Behavioral~~ Behavioral Verilog

B. Structural Verilog

P3. A.
```
module Q1( f, a, b, c) ;
input a, b, c;
output f;

not ( k, a);
not (g, b);
~~or~~ and (h, k, g);
or ( i, h, c);
and (j, k, c);
or (l, j, b);
and (f, i, l);

endmodule
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B. module Q1(f, a, b, c);
input a, b, c;
output f;
reg f;

always @(a or b or c)
if(a == 0)
f = b + c;
else
f = 0;

endmodule

P4. A. $\bar{w}\bar{x}y + \bar{w}xy + w\bar{x}\bar{y} + wxy$

$= \bar{w}y(\bar{x} + x) + w\bar{x}\bar{y} + wxy$ (Distributive)

$= \bar{w}y + w\bar{x}\bar{y} + wxy$ (Complement)

$\Rightarrow \bar{w}y + wx$ (Similarly with $\bar{y}$)

B. module P4(w, x, y, z);
input w, x, y;
output z;

not(k, w);
and(g, k, y);
and(h, w, x);
or(z, g, h);

endmodule

C. module P4 (w, x, y, z);
input w, x, y;
output z;

assign z = (w & x) | (~w & y);

endmodule

D. module P4 (w, x, y, z);
input w, x, y;
output z;
reg z;

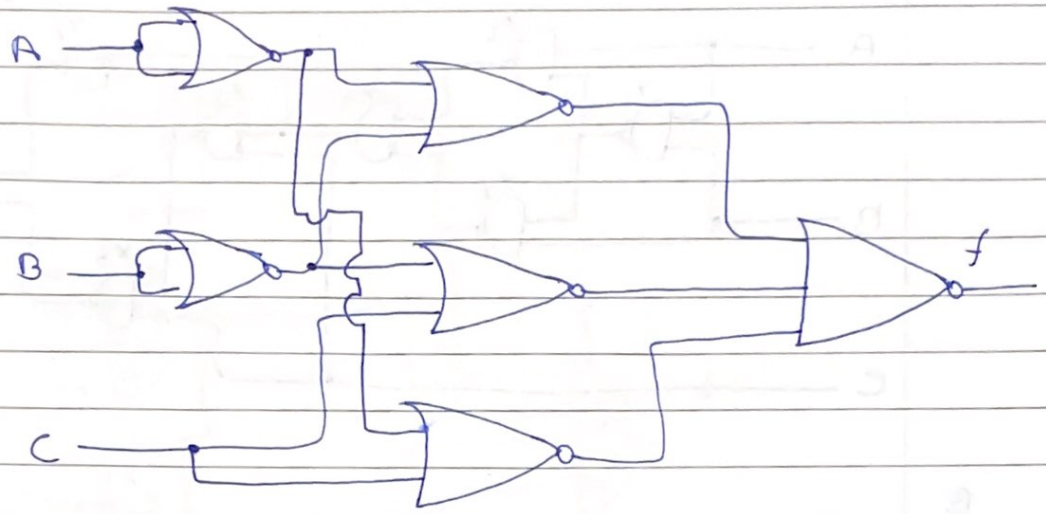
always @ (w or x or y)
if (w == 0)
z = x;
else
z = y;

endmodule

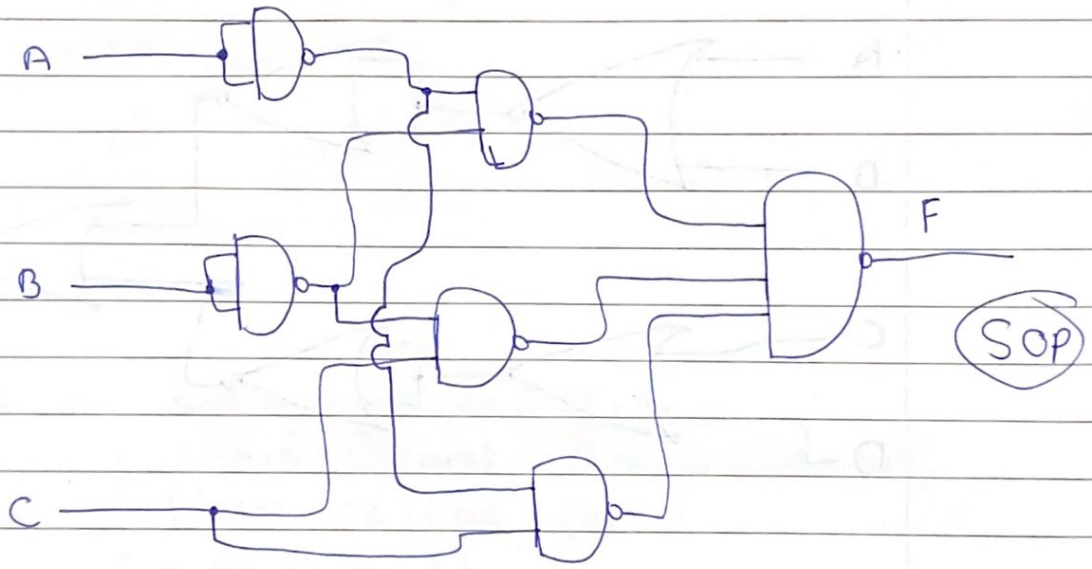
P5. A. $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C = \bar{A}\bar{B} + C\bar{B} + C\bar{A}$

B. $(A + \bar{B} + C)(\bar{A} + B + C)(\bar{A} + \bar{B} + C)(\bar{A} + \bar{B} + \bar{C})$
$= (A + \bar{B} + C)(\bar{A} + B + C)(\bar{A} + \bar{B} + C\bar{C})$ ~~$\bar{B}C + \bar{B}\bar{A} + C\bar{A}$~~
$= (A + \bar{B} + C)(\bar{A} + B + C)(\bar{A} + \bar{B})$
$= (\bar{A} + C)(\bar{B} + C)(\bar{A} + \bar{B})$

C.




D.




E. POS for part C
SOP for part D

Using POS for NOR Gates makes it easier & similarly for SOP & NAND Gates.

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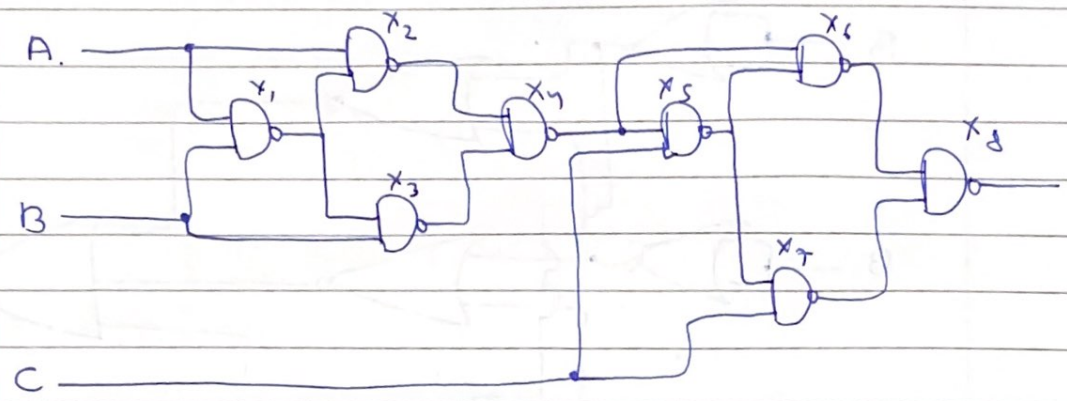
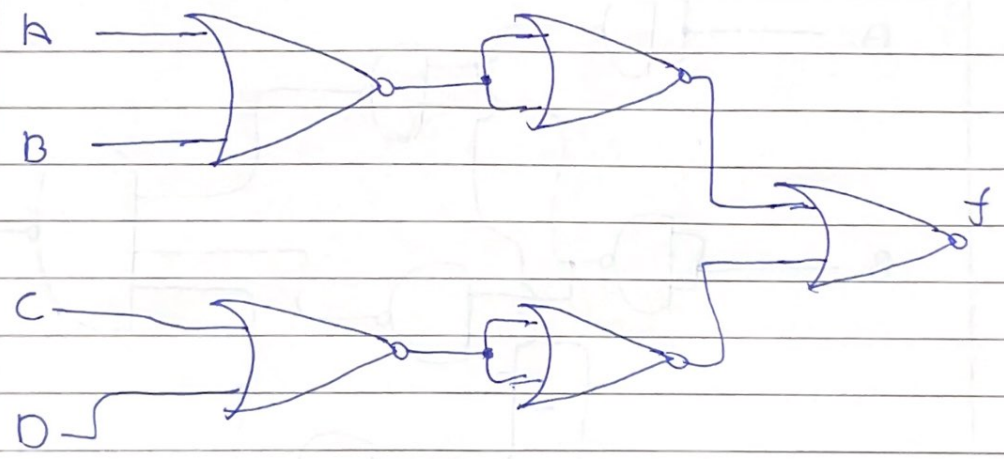
P6. A.




B.



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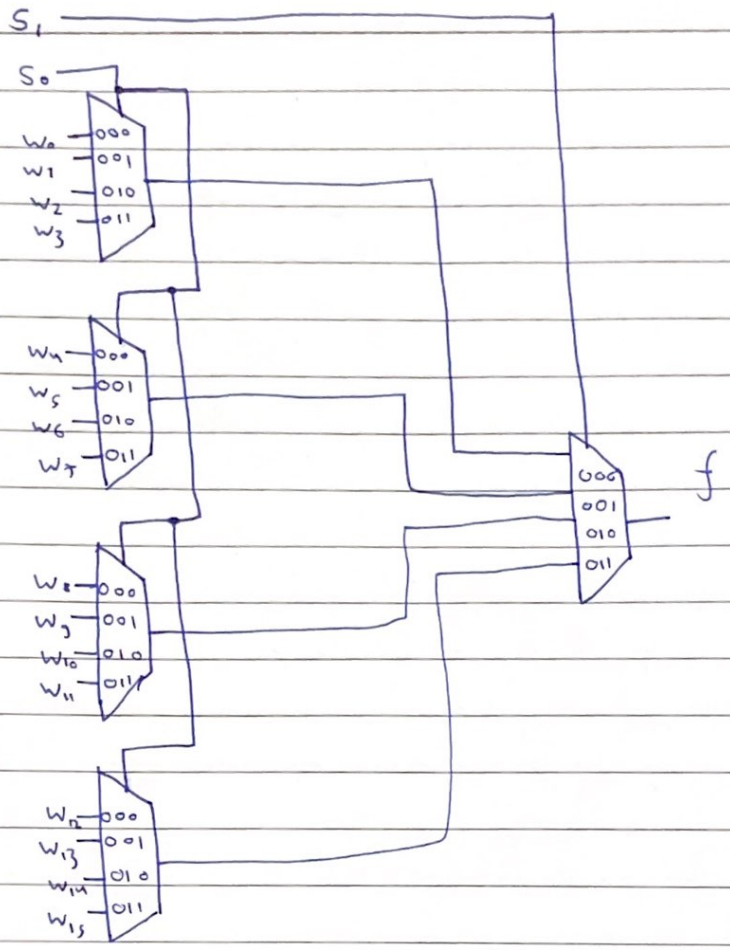
C.




P7. a) $M = (A+B+C)(A+B+\bar{C})(\bar{A}+B+\bar{C})$

$= (((A+B)+C)((A+B)+\bar{C})(A+(B+\bar{C}))(\bar{A}+(B+\bar{C}))$

$= ((A+B)+C\bar{C})(A\bar{A}+(B+\bar{C}))$

$= (A+B)(B+\bar{C})$

b) $M = (A+\bar{B}+\bar{C})(\bar{A}+B+C)(\bar{A}+\bar{B}+\bar{C})(A+\bar{B}+C)(\bar{A}+\bar{B}+C)$

c)