Logic Design – Tutorial 04

#	Student ID	Student Name	Grade (10)
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Q 1 Demonstrate the validity of the following identities by means of truth tables:

(a) DeMorgan's theorem for three variables: $(x + y + z)' = x'y'z'$ and $(xyz)' = x' + y' + z'$

(b) The distributive law: $x + yz = (x + y)(x + z)$

Sol 1

(a)

x y z	$x + y + z$	$(x + y + z)'$	x'	y'	z'	$x'y'z'$
0 0 0	0	1	1	1	1	1
0 0 1	1	0	1	1	0	0
0 1 0	1	0	1	0	1	0
0 1 1	1	0	1	0	0	0
1 0 0	1	0	0	1	1	0
1 0 1	1	0	0	1	0	0
1 1 0	1	0	0	0	1	0
1 1 1	1	0	0	0	0	0

$x\ y\ z$	(xyz)	$(xyz)'$	x'	y'	z'	$x' + y' + z'$
0 0 0	0	1	1	1	1	1
0 0 1	0	1	1	1	0	1
0 1 0	0	1	1	0	1	1
0 1 1	0	1	1	0	0	1
1 0 0	0	1	0	1	1	1
1 0 1	0	1	0	1	0	1
1 1 0	0	1	0	0	1	1
1 1 1	1	0	0	0	0	0

(b)

$x\ y\ z$	$x + yz$	$(x + y)$	$(x + z)$	$(x + y)(x + z)$
0 0 0	0	0	0	0
0 0 1	0	0	1	0
0 1 0	0	1	0	0
0 1 1	1	1	1	1
1 0 0	1	1	1	1
1 0 1	1	1	1	1
1 1 0	1	1	1	1
1 1 1	1	1	1	1

Q2 Simplify the following Boolean expressions to a minimum number of literals:

(a)* $xy + xy'$

(c)* $xyz + x'y + xyz'$

(e) $xyz' + x'yz + xyz + x'yz'$

Sol 2

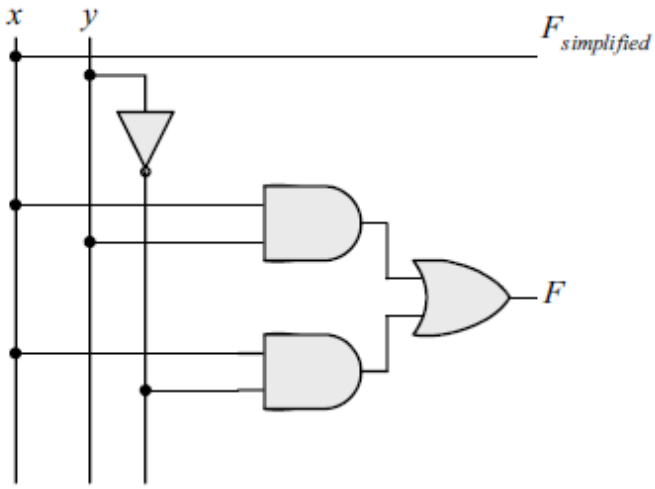
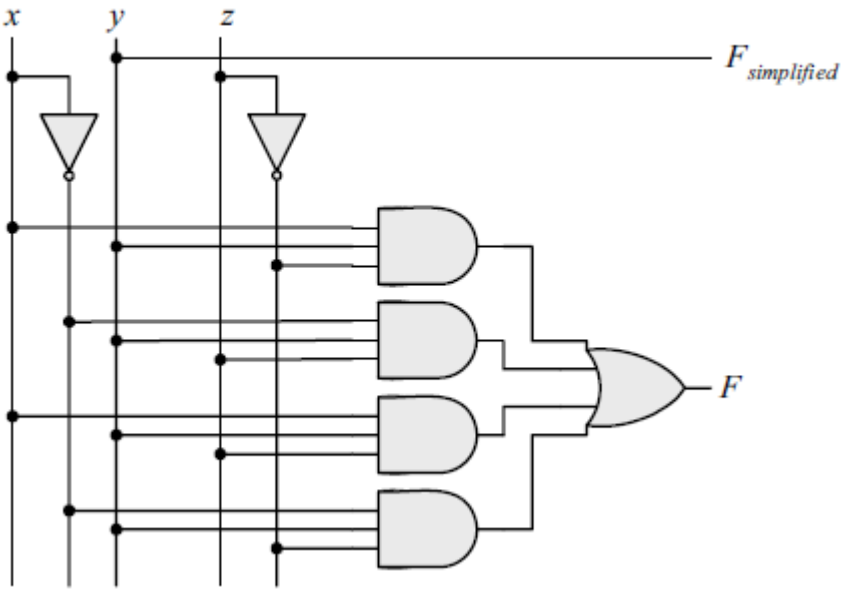
(a) $xy + xy' = x(y + y') = x$

(c) $xyz + x'y + xyz' = xy(z + z') + x'y = xy + x'y = y$

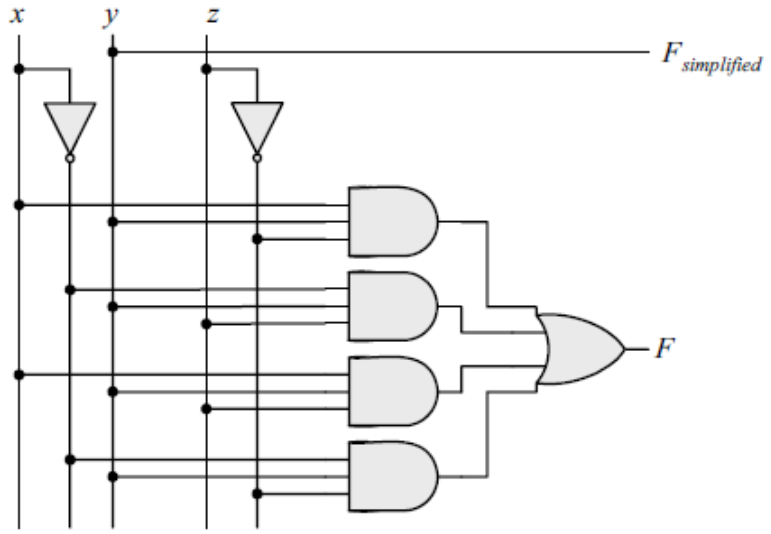
(e) $xyz' + x'yz + xyz + x'yz' = xy(z + z') + x'y(z + z') = xy + x'y = y$

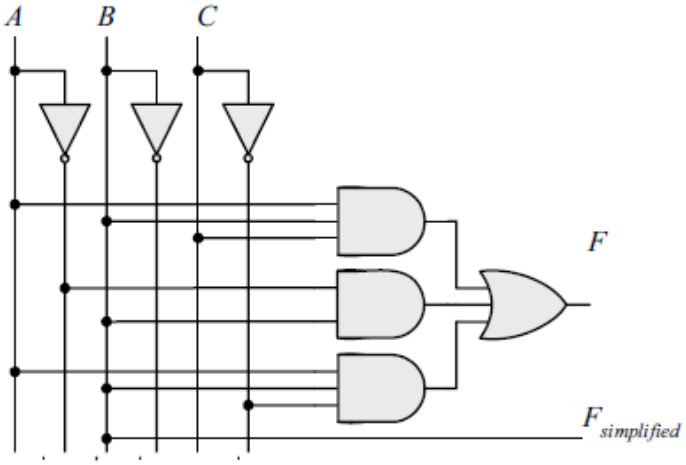
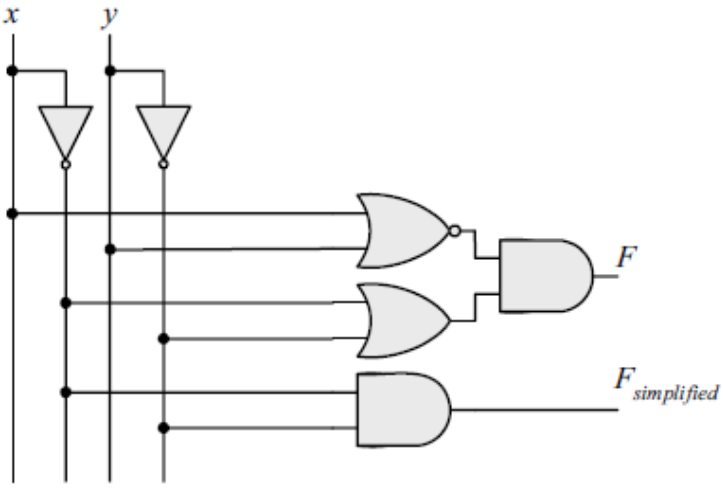
Q 3	Simplify the following Boolean expressions to a minimum number of literals: (a)* $ABC + A'B + ABC'$ (c)* $(x + y)'(x' + y')$ (e)* $(BC' + A'D)(AB' + CD')$
Sol 3	**(a)** $ABC + A'B + ABC' = AB + A'B = B$ **(c)** $(x + y)'(x' + y') = x'y'(x' + y') = x'y'$ **(e)** $(BC' + A'D)(AB' + CD') = BC'AB' + BC'CD' + A'DAB' + A'DCD' = 0$

Q4	Reduce the following Boolean expressions to the indicated number of literals: (a)* $A'C' + ABC + AC'$ to three literals (b)* $(x'y' + z)' + z + xy + wz$ to three literals
Sol 4	**(a)** $A'C' + ABC + AC' = C' + ABC = (C + C')(C' + AB) = AB + C'$ **(b)** $(x'y' + z)' + z + xy + wz = (x'y')'z' + z + xy + wz = [(x + y)z' + z] + xy + wz =$ $= (z + z')(z + x + y) + xy + wz = z + wz + x + xy + y = z(1 + w) + x(1 + y) + y = x + y + z$

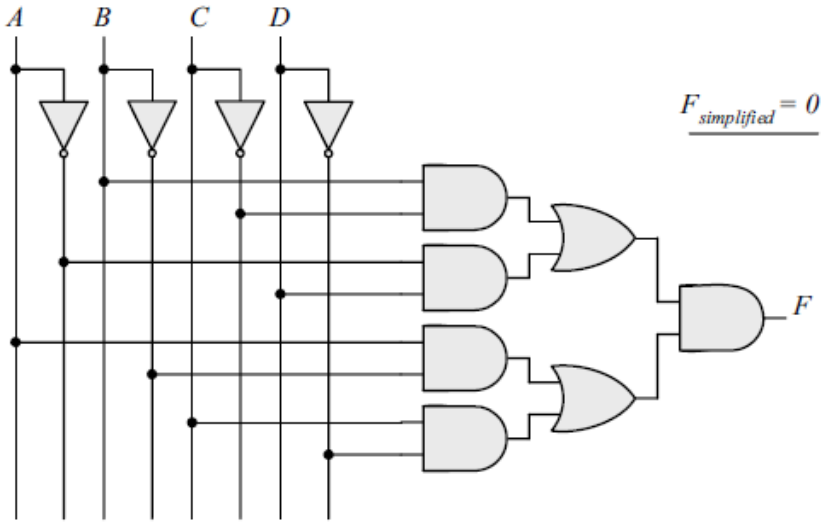
Q5	Draw logic diagrams of the circuits that implement the original and simplified expressions in Q2 (a)* $xy + xy'$ (c)* $xyz + x'y + xyz'$ (e) $xyz' + x'yz + xyz + x'yz'$
Sol 5	**(a)**  

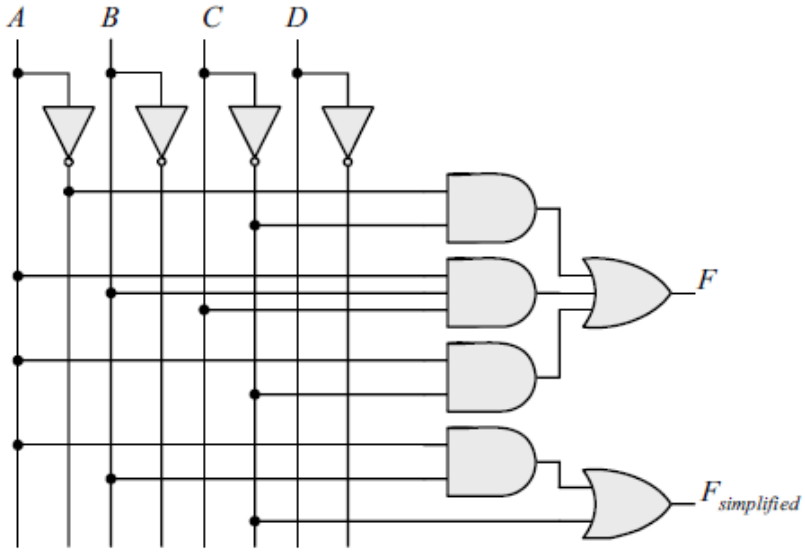
(e)



Q6	Draw logic diagrams of the circuits that implement the original and simplified expressions in Q3 (a)* $ABC + A'B + ABC'$ (c)* $(x + y)'(x' + y')$ (e)* $(BC' + A'D)(AB' + CD')$
Sol 6	**(a)**  **(c)** 

(e)



Q7	Draw logic diagrams of the circuits that implement the original and simplified expressions in Q4 (a)* $A'C' + ABC + AC'$ to three literals (b)* $(x'y' + z)' + z + xy + wz$ to three literals
Sol 7	**(a)**  **(b)**