EXERCISES

Q1. Let $E = (xy)' + x' + y = 1$. Find E^d , (E^d or $\bar{E}$ is the **Duality** of E)

Q2. Let B is a Boolean Algebra and $x, y \in B$. Show that $x + y = xy + xy' + x'y$ is valid.

Q3. Let $f(x,y,z) = x(y+z') + y'$. Find $CSP(f)$ (sum-of-products expansion) and $CPS(f)$ (product-of-sums expansion) ?

Q4. Let $f(x, y, z) = x'z + yz'$. Find $CSP(f)$ (sum-of-products expansion) and $CPS(f)$ (product-of-sums expansion) ?

Q5. Let $f(x, y, z) = (x' + z)(x + y)$. Find $CSP(f)$ (sum-of-products expansion) and $CPS(f)$ (product-of-sums expansion) ?

Q6. Let $f(x, y, z) = (x' + y)' \, (x + y + z)$

(i) Use NAND gates to construct circuits with this output.

(ii) Use NOR gates to construct circuits with this output.

Q7. Let $f(x, y, z) = (x + y)(x' + yz')$

(i) Find $CSP(f)$ and $CPS(f)$.

(ii) Find $MSP(f)$ and $MPS(f)$.

(iii) Construct a minimal circuit using (AND-OR) gates, with $f(x, y, z)$ output.

Q8. Let $f(x, y, z) = xy' + xz + y'z' + x'yz'$

(i) Find the Karnaugh -map for $f(x, y, z)$.

(ii) Find $MSP(f)$ and $MPS(f)$.

(iii) Construct a minimal circuit using (AND-OR) gates, with $f(x, y, z)$ output.

(iv) Use NAND gates to construct circuits with $f(x, y, z)$ output.

(v) Use NOR gates to construct circuits with $f(x, y, z)$ output.

Q9. Let $g(x,y,z) = xy'z + x'yz + x'y'z' + y'z$

(i) Find the Karnaugh -map for $g(x,y,z)$.

(ii) Find $MSP(g)$ and $MPS(g)$.

(iii) Construct a minimal circuit using (AND-OR) gates, with $g(x,y,z)$ output.

(iv) Use NAND gates to construct circuits with $g(x,y,z)$ output.

(v) Use NOR gates to construct circuits with $g(x,y,z)$ output.

Q10. Let

	yz	yz'	$y'z'$	$y'z$
x				1
x'	1	1		1

Be the Karnaugh -map for $g(x, y, z)$.

(i)Find $MSP(g)$ and $MPS(g)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $g(x, y, z)$ output.

(iii)Use NAND gates to construct circuits with $g(x, y, z)$ output.

(iv)Use NOR gates to construct circuits with $g(x, y, z)$ output.

Q11. Let

	yz	yz'	$y'z'$	$y'z$
x	1			1
x'	1	1		1

Be the Karnaugh -map for $g(x, y, z)$.

(i)Find $MSP(g)$ and $MPS(g)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $g(x, y, z)$ output.

(iii)Use NAND gates to construct circuits with $g(x, y, z)$ output.

(iv)Use NOR gates to construct circuits with $g(x, y, z)$ output.

Q12. Let

	zw	zw'	$z'w'$	$z'w$
xy		1		1
xy'	1	1	1	1
$x'y'$	1		1	
$x'y$				

Be the Karnaugh -map for $f(x, y, z)$.

(i)Find $MSP(f)$ and $MPS(f)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $f(x, y, z)$ output.

(iii)Use NAND gates to construct circuits with $f(x, y, z)$ output.

(iv)Use NOR gates to construct circuits with $f(x, y, z)$ output.

Q13. Let

	zw	zw'	$z'w'$	$z'w$
xy		1		1
xy'	1	1	1	1
$x'y'$	1		1	
$x'y$				

Be the Karnaugh -map for $f(x,y,z)$.

(i)Find $MSP(f)$ and $MPS(f)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $f(x,y,z)$ output.

(iii)Use NAND gates to construct circuits with $f(x,y,z)$ output.

(iv)Use NOR gates to construct circuits with $f(x,y,z)$

Q14. Let

	zw	zw'	$z'w'$	$z'w$
xy		1	1	
xy'	1	1	1	
$x'y'$		1	1	
$x'y$	1	1	1	1

Be the Karnaugh -map for $f(x,y,z)$.

(i)Find $MSP(f)$ and $MPS(f)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $f(x,y,z)$ output.

(iii)Use NAND gates to construct circuits with $f(x,y,z)$ output.

(iv)Use NOR gates to construct circuits with $f(x,y,z)$

Q15. Let

	zw	zw'	$z'w'$	$z'w$
xy	1	1	1	1
xy'		1	1	
$x'y'$		1	1	
$x'y$			1	

Be the Karnaugh -map for $f(x,y,z)$.

(i)Find $MSP(f)$ and $MPS(f)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $f(x,y,z)$ output.

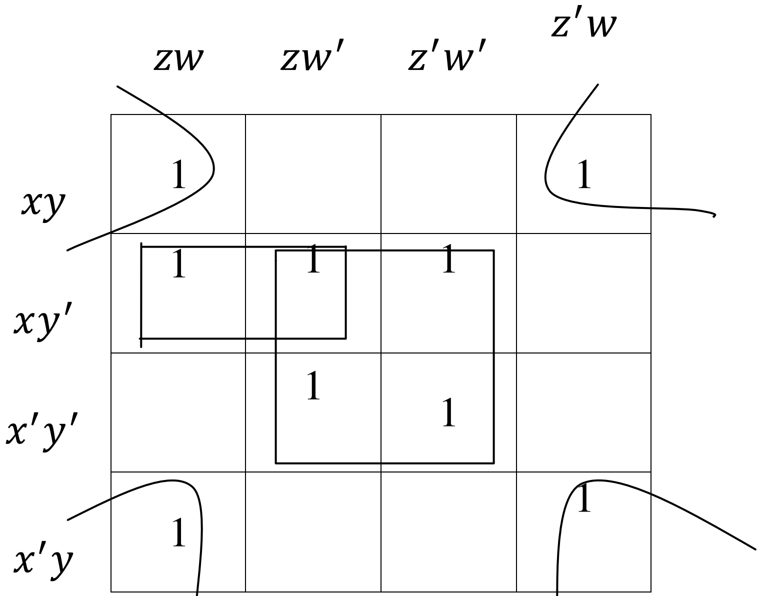
(iii)Use NAND gates to construct circuits with $f(x,y,z)$ output.

(iv)Use NOR gates to construct circuits with $f(x,y,z)$

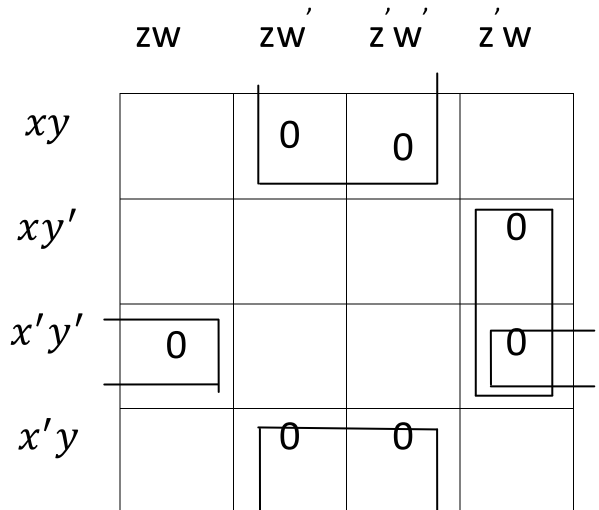
Q16 .

	zw	zw'	z'w'	z'w
xy	1	0	1	1
xy'	1	0	0	1
$x'y'$	0	0	0	0
$x'y$	1	1	0	0

Q17.



شكل كارنو للدالة f



متمم كارنو للدالة f'

ASSIGMENT

Q1. Find CSP(sum-of-products expansion) and CPS (product-of-sums expansion) for the following Boolean functions

1- $f(x,y,z) = (x+z)(x'+y)'$

2- $f(x,y,z) = z(y+x') + y'$.

3- $f(x,y,z) = (x+yz)(y+xz')$.

4- $g(x,y,z) = xy + z$.

5- $f(x,y,z) = xy' + z$.

6- $f(x,y,z) = (x' + y)'(yz')'$.

7- $g(x,y,z) = xz + y'z'$.

8- $f(x,y,z) = 1$ when $x = y$.

Q2. Let $h(x,y,z) = xy' + xyz + y'z' + x'yz'$

(i) Find the Karnaugh -map for $h(x,y,z)$.

(ii) Find $MSP(h)$ and $MPS(h)$.

(iii) Construct a minimal circuit using AND gates, OR gates, with $h(x,y,z)$ output.

(iv) Use NAND gates to construct circuits with $h(x,y,z)$ output.

(v) Use NOR gates to construct circuits with $h(x,y,z)$ output.

Q3. Let $f(x,y,z) = xy' + xz + yz + x'yz'$

(i) Find the Karnaugh -map for $f(x,y,z)$.

(ii) Find $MSP(f)$ and $MPS(f)$.

(iii) Construct a minimal circuit using AND gates, OR gates, with $f(x,y,z)$ output.

(iv) Use NAND gates to construct circuits with $f(x,y,z)$ output.

(v) Use NOR gates to construct circuits with $f(x,y,z)$ output.

Q4. Let the Karnaugh -maps for $f(x,y,z)$ given as bellow from exercise 1-15

(i)Find $MSP(f)$ and $MPS(f)$.

(ii)Construct a minimal circuit using (AND-OR) gates, with $f(x,y,z)$ output.

(iii)Use NAND gates to construct circuits with $f(x,y,z)$ output.

(iv)Use NOR gates to construct circuits with $f(x,y,z)$ output.

1-

	zw	zw'	$z'w'$	$z'w$
xy	1			1
xy'			1	1
$x'y'$			1	1
$x'y$	1		1	1

2-

	zw	zw'	$z'w'$	$z'w$
xy	1	1		1
xy'	1	1		1
$x'y'$				
$x'y$	1	1	1	

3-

	zw	zw'	z'w'	z'w
xy	1			1
xy'		1		
$x'y'$				
$x'y$	1		1	1

4-

	zw	zw'	z'w'	z'w
xy		1		
xy'				
$x'y'$	1			1
$x'y$	1	1	1	1

5-

	zw	zw'	z'w'	z'w
xy	1	1		1
xy'		1	1	
$x'y'$	1			1
$x'y$	1			1

6-

	zw	zw'	z'w'	z'w
xy	1	1	1	1
xy'	1	1		1
$x'y'$	1			
$x'y$	1			

7-

	zw	zw'	z'w'	z'w
xy	1	1	1	1
xy'	1			
$x'y'$				1
$x'y$	1	1	1	1

8-

	zw	zw'	z'w'	z'w
xy	1			1
xy'		1	1	1
$x'y'$		1	1	1
$x'y$	1			1

9-

	zw	zw'	z'w'	z'w
xy			1	
xy'		1	1	
$x'y'$		1	1	
$x'y$	1	1	1	1

10-

	zw	zw'	z'w'	z'w
xy		1	1	1
xy'		1	1	1
$x'y'$				1
$x'y$				

11-

	zw	zw'	z'w'	z'w
xy	1	1	1	1
xy'	1			
$x'y'$	1			
$x'y$	1		1	1

12-

	zw	zw'	$z'w'$	$z'w$
xy	1	1		1
xy'		1		
$x'y'$				
$x'y$	1		1	1

13-

	zw	zw'	$z'w'$	$z'w$
xy	1		1	1
xy'	1			1
$x'y'$				
$x'y$	1	1		

14-

	zw	zw'	$z'w'$	$z'w$
xy	1		1	1
xy'	1		1	1
$x'y'$			1	
$x'y$			1	1

15-

	zw	zw'	$z'w'$	$z'w$
xy	1	1	1	1
xy'	1	1	1	
$x'y'$		1	1	
$x'y$			1	