0907231 Digital Logic	**First Exam**	**Summer 2018**
9 Problems, 5 Pages	**75 Minutes**	**July 8th, 2:30 PM**
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28.5

7

Problem 1: Solve the following short questions. **(7 points)**

a) $(123.14)_5$ is equal to ($38 + \frac{9}{25}$)$_{10}$

$1\times5^2 + 2\times5^1 + 3\times5^0 + 1\times5^{-1} + 4\times5^{-2}$

$25 + 10 + 3 + \frac{1}{5} + \frac{4}{25}$

$38 \quad \frac{9}{25}$

b) $(70.125)_{10}$ is equal to (1012.02)$_4$

70/4	17	2	Least
1/4	4	1	
4/4	1	0	
1/4	0	1	most

$0.125 \times 4 = 0.5$ max

$0.5 \times 4 = 2.0$ least

c) $(FB1.19)_{16}$ is equal to (7661.062)$_8$

7	6	6	1	0	6	2

d) $(0101\,0011\,1000)_{BCD}$ is equal to (538)$_{10}$

5 3 8

$n^5 = 32$ $n^6 = 64$ $n^7 = 128$ $n^8 = 256$ $n^9 = 512$ $n^{10} = 1024$

$M = 950$

e) If the total number of books in a public library is 950. Then what is the ***minimum*** number of digits needed to encode the number of books in binary ***(i.e. radix =2)***.....$2^n \geq 950 > 2^{n-1}$

$n = 10$

$2^n \geq M > 2^{n-1}$

$2^n \geq 950 > 2^{n-1}$

$x\bar{y} + xyz + xyz + xy\bar{z} + xy\bar{z}$

$x\bar{y} + xyz + xy\bar{z}$

Problem 4: Using ***Boolean algebra***, prove the following relational statement. ***Show your steps clearly***. **(3 points)**

$$x\bar{y} + (xyz + y\bar{z})(xyz + x) = x$$

$= x\bar{y} + xyz + xyz + xy\bar{z} + xy\bar{z}$

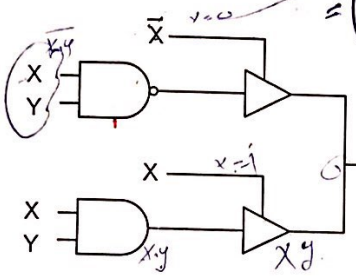
$= x\bar{y} + xy(z + \bar{z})$

$= x\bar{y} + xy$

$= x(\bar{y} + y)$

$= x$

Problem 5: Determine the ***Sum of Minterms (SOM)*** algebraic expression for $F(X,Y)$ that is implemented by the circuit given below. **(3 points)**



$= (\bar{X} \cdot \bar{X}\bar{Y}) + (X \cdot XY)$

$\bar{X} \cdot (\bar{X} + \bar{Y}) + X \cdot Y$

$\bar{X} + \bar{X}\bar{Y} + XY$

$= \bar{X} + \bar{X}\bar{Y} + XY$

$= \bar{X}(Y + \bar{Y}) + \bar{X}\bar{Y} + XY$

$= \bar{X}Y + \bar{X}\bar{Y} + \bar{X}\bar{Y} + XY$

$= \bar{X}Y + \bar{X}\bar{Y} + XY$

$$F(X,Y) = \bar{X}Y + \bar{X}\bar{Y} + XY$$

Problem 6: ***Draw and Fill*** the K-map of function F given by the following Boolean expression. ***You must label the K-map with the input variables***. **(4 points)**

$$F(W,X,Y,Z) = X\bar{Y} + \bar{W}\bar{X}\bar{Z} + W\bar{X}Y\bar{Z}$$

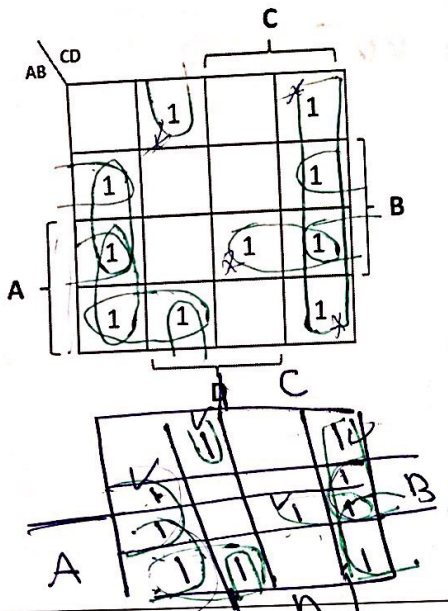
$= wx\bar{y} + \bar{w}x\bar{y}$

$= wx\bar{y}z + wx\bar{y}\bar{z} + \bar{w}x\bar{y}z + \bar{w}x\bar{y}\bar{z} + \bar{w}\bar{x}\bar{y}\bar{z} + \bar{w}\bar{x}\bar{y}\bar{z}$

$= \sum_m (0, 4, 5, 10, 12, 13)$

1	1	3	2 X
4 1	5 1	7	6
12 1	13 1	15	14
9	8	11	10 1

Problem 7: Consider the following K-map for function $F(A,B,C,D)$, identify the expressions of the ***six*** prime implicants and determine which are essential. **(3 points)**



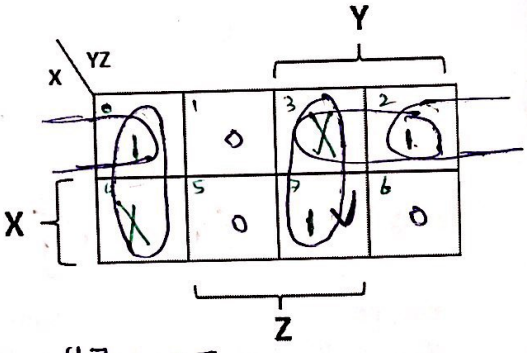
Prime Implicant Expression	Is it Essential?
$\bar{B}\bar{C}D$	✓
$C\bar{D}$	✓
$B\bar{D}$	✓
$A\bar{D}$	
$A\bar{C}\bar{B}$	
ABC	✓

$\bar{B}\bar{C}D$ ✓ $C\bar{D}$ ✓ $B\bar{D}$ ✓ $A\bar{D}$ $A\bar{C}\bar{B}$ ABC ✓

Problem 8: Use the K-map below to find the ***optimized*** Boolean expression of function $F(X,Y,Z)$ as ***Sum of Products (SoP)***. **(2 points)**

$$F(X,Y,Z) = \sum_m (0,2,7) + \sum_d (3,4)$$

$F = YZ + \bar{X}\bar{Z}$

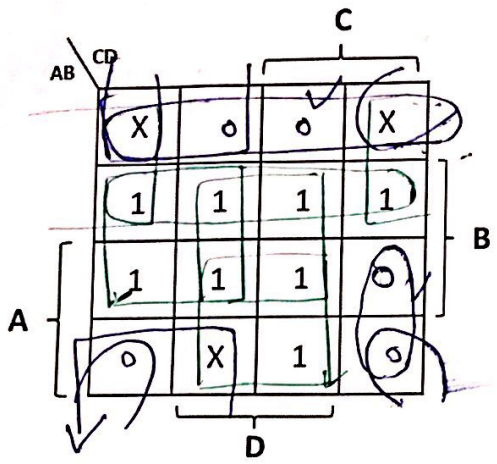


YZ $\bar{X}\bar{Z}$

YZ ↓ essential — $\bar{X}\bar{Z}$ → non essential

$F(X,Y,Z) = YZ + \bar{X}\bar{Z}$

Problem 9: Given the K-map of function $F(A,B,C,D)$, write the ***optimized*** Boolean expression of F as ***Product of Sums (PoS).*** **(3 points)**



$B\bar{C} + AD + \bar{A}B$

$$\bar{F} = B\bar{C} + AD + \bar{A}B$$

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

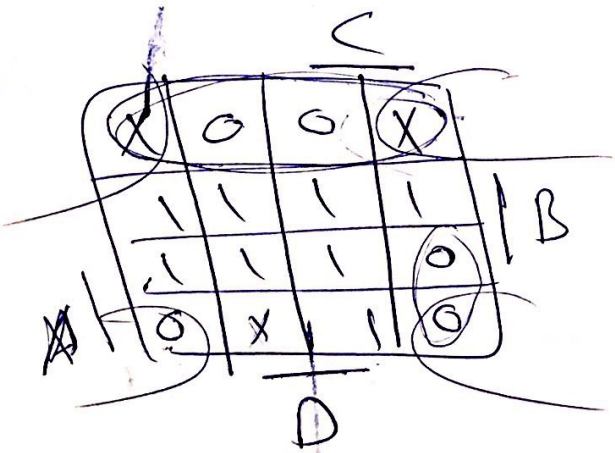
- complement ← zero

$$F = \bar{A}\bar{B} + \bar{B}\bar{D} + AC\bar{D}$$

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

$$\boldsymbol{F(A,B,C,D) = (A+B)\cdot(B+D)\cdot(\bar{A}+\bar{C}+D)}$$

$\bar{f}$



$$\bar{f} = \bar{A}\bar{B} + \bar{B}\bar{D} + AC\bar{D}$$