National University of Computer and Emerging Sciences, Lahore Campus

Course:	Digital Logic Design	Course Code:	EE1005
Program:	BS(Computer Science/ Data Science)	Semester:	Spring 2022
Duration:	60 Minutes	Total Marks:	50
Paper Date:	24/03/2022	Weight	15%
Section:	ALL	Page(s):	4
Exam:	Midterm-I	Roll No.	_____
		Section:	

Instruction/Notes:
- *Attempt all the questions on this answer booklet.*
- *Make sure to write down your roll # on EVERY sheet in the given space.*
- ***Use of calculator is not allowed.***

Question 1 [10 Marks]: Determine the value of the radix r if $(112)_r = (1012)_3$

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$\Rightarrow r^2 + r + 2 = 3^3 + 3^1 + 2 \times 3^0$

$\Rightarrow r^2 + r + 2 = 32$

$\Rightarrow r^2 + r - 30 = 0$

$\Rightarrow (r-5)(r+6) = 0.$

$\Rightarrow \boxed{r = 5}.$ $r = -6$ is not valid.

Question 2 [10 + 6 = 16 Marks]: Design a combinational circuit with a 4-bit input. The 4-bit input represents the month number, 0001 for January, 0010 for February, 0011 for March and so on. The circuit has three outputs F_2, F_1, F_0 as shown in Figure 1.

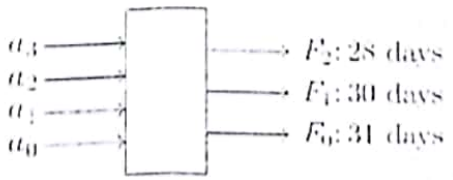


Figure 1: Number of days calculator.

The output F_2 is 1 if the input month has 28 days.

The output F_1 is 1 if the input month has 30 days,

and output F_0 is 1 if the input month has 31 days. Ignore the leap year.

For invalid inputs, it doesn't matter what's the output.

(a) Fill-in the entries for the outputs in the truth table shown below:

Inputs				Outputs		
a_3	a_2	a_1	a_0	F_2	F_1	F_0
0	0	0	0	X	X	X
0	0	0	1	0	0	1
0	0	1	0	1	0	0
0	0	1	1	0	0	1
0	1	0	0	0	1	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	0	1
1	0	0	0	0	0	1
1	0	0	1	0	1	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
1	1	0	0	0	0	1
1	1	0	1	X	X	X
1	1	1	0	X	X	X
1	1	1	1	X	X	X

(b) Write the function F_2 and F_0 in Sum of Minterms form and F1 in Product of Maxterm form.

$F_2(a_3, a_2, a_1, a_0) = \Sigma m(2) + \Sigma d(0, 13, 14, 15)$

$F_1(a_3, a_2, a_1, a_0) = \Pi M(1, 2, 3, 5, 7, 8, 10, 12) + \Sigma d(0, 13, 14, 15)$

$F_0(a_3, a_2, a_1, a_0) = \Sigma m(1, 3, 5, 7, 8, 10, 12) + \Sigma d(0, 13, 14, 15)$

Roll #_____

Question 3 [4 +10 +10 = 24 Marks]: A Boolean function is given as follows:

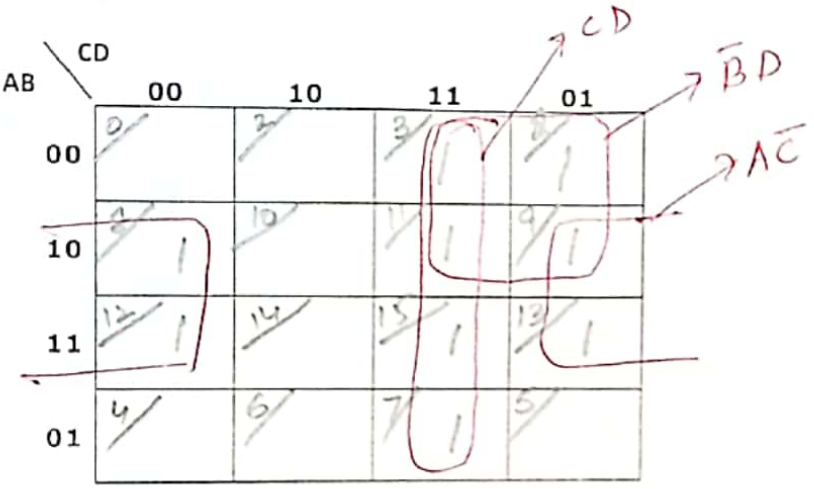
$$F(A, B, C, D) = AC' + B'D + A'CD + ABCD$$

a) Write down the function F in Sum of Minterms and Product of Maxterm form.

$F(A, B, C, D) = \Sigma m(1, 3, 7, 8, 9, 11, 12, 13, 15)$

$F(A, B, C, D) = \Pi M(0, 2, 4, 5, 6, 10, 14)$

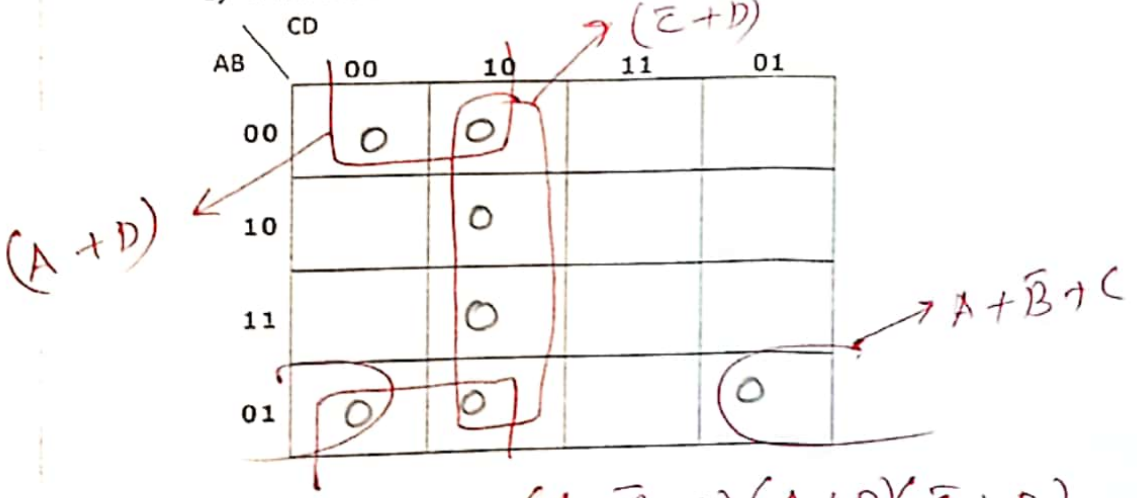
b) Minimize the function F in Sum of Products form using K-maps shown below:



Minterms
AC̄ 8, 9, 12, 13
B̄D 1, 3, 9, 11
A'CD 3, 7
ABCD 15

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

c) Minimize the function F in Product of Sums form using K-maps shown below:



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