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 $(112)_r = (1012)_3$

$(1012)_3$ Converting it in decimal

$$1 \times 3^3 + 0 \times 3^2 + 1 \times 3^1 + 3 \times 2$$

$$27 + 3 + 2 = (32)_{10}$$

Now $(112)_r$

converting it in Base 5

$$1 \times 5^2 + 1 \times 5^1 + 5 \times 2$$

$$25 + 5 + 2 = (32)_5$$

It means if $(112)_r = (1012)_3$

So $r = 5$

10

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.

J   0 0 0 1

F   0 0 1 0

M   0 0 1 1

A   0 0 0 0

a_3 ———→ F_2: 28 days
a_2 ———→ F_1: 30 days
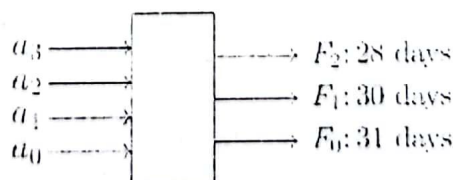a_1 ----→ F_0: 31 days
a_0 ----→

Figure 1: Number of days calculator.

1/4

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	✗	✗	✗	o
0	0	0	1	0	X0	0 1	1
0	0	1	0	1	0	0	2
0	0	1	1	0	0	1	3
0	1	0	0	0	1	0	4
0	1	0	1	0	0	1	5
0	1	1	0	0	1	0	6
0	1	1	1	0	0	1	7
1	0	0	0	0	0	1	8
1	0	0	1	0	1	0	9
1	0	1	0	0	0	1	10
1	0	1	1	0	1	0	11
1	1	0	0	0	0	1	12
1	1	0	1	✗	✗	✓	
1	1	1	0	✗	✗	✓	
1	1	1	1	✗	✗	✓	

30 J
28 F
31 M
30 A
31 May
30 J
31 Jl
31 Aus
30 Sep
31 Oct
30 Nov
31 Dec

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

$F_2 (a_3, a_2, a_1, a_0) = \Sigma m (\quad 2 \qquad)$

$F_1 (a_3, a_2, a_1, a_0) = \Pi M (\quad 2, 3, 5, 7, 8, 10, 12 \quad)$

$F_0 (a_3, a_2, a_1, a_0) = \Sigma m (1, 3, 5, 7, 8, 10, 12 \quad)$

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.

$$F(A, B, C, D) = \Sigma m(1, 3, 7, 8, 9, 11, 12, 14, 15, 13)$$

$$F(A, B, C, D) = \Pi M(0, 1, 2, 4, 5, 6, 10, 14)$$

(handwritten: 14)

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

(red handwritten: wrongly placed)

$$F(A, B, C, D) = \underline{ABC' + CD + A'BD' + AB + CD + A'B'C + A'BD'}$$

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

$$F(A, B, C, D) = (B + D) \cdot (A' + C'D) \cdot (A + CD') \cdot (B + CD')$$
$$(A + CD) \cdot (A + C) \cdot (A + \underline{\quad})$$

(red handwritten: Not P.O.S form)