National University of Computer and Emerging Sciences, Lahore Campus

Course:	Digital Logic Design Lab	Course Code:	EL-227
Program:	BS(Computer Science)		
Duration:	45 minutes	Total Marks:	45
Paper Date:	20 March 2024		
Section:	E sec	Page(s):	1
Exam:	MID LAB EXAM		

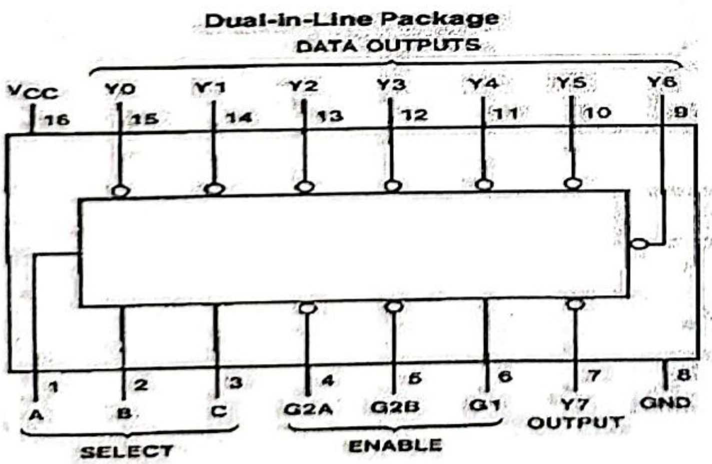
Note: 45 min inclusive of hardware and software.

Question 1:

Design a combinational circuit with a decoder to accept a 3-bit number and generate the output binary number equal to the square of the input number.

1. **Give Truth table & Boolean expression for given problem (5)** 5
2. **Design it with 3 TO 8-line decoder (restriction is: Do it with NOR gates only).**
    - **Implement it on logic works (20)** 20
    - **Implement it on logic trainer (20)**

$\overline{A+B}$



$AND = AB = \overline{\bar{A}+\bar{B}} = AB$

$NAND = \overline{AB} = \cancel{\bar{A}\bar{B}}$

$\overline{\overline{\bar{A}+\bar{B}}} = \bar{A}+\bar{B} = \overline{AB}$

$\overline{\bar{A}+\bar{B}}$

(3,5)

Function Tables

DM74LS138

Inputs					Outputs							
Enable		Select										
G1	G2 (Note 1)	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Level
L = LOW Level
X = Don't Care

Note 1: G2 = G2A + G2B

$7^2 = 49$
$= 6$ bits.

	I_2	I_1	I_0	O_5	O_4	O_3	O_2	O_1	O_0
$0^2=0$	0	0	0	0	0	0	0	0	0
$1^2=1$	0	0	1	0	0	0	0	0	1
$2^2=4$	0	1	0	0	0	0	1	0	0
$3^2=9$	0	1	1	0	0	1	0	0	1
$4^2=16$	1	0	0	0	1	0	0	0	0
$5^2=25$	1	0	1	0	1	1	0	0	1
$6^2=36$	1	1	0	1	0	0	1	0	0
$7^2=49$	1	1	1	1	1	0	0	0	1

NAND

2	25 =	
2	12	1
	6	0
	3	0
	1	1

2	49	
	24	1
	12	0
	6	0
	3	0
	1	1

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

$= A\bar{B}$ ✓

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

$C(\bar{A}B + A\bar{B})$

$C(A \oplus B)$

$O_0 = I_0 = \cancel{\Pi M}\ \Sigma m(1, 3, 5, 7)$

$O_1 = 0 = 0.$

$O_2 = \bar{I_2} I_1 \bar{I_0} + I_2 I_1 \bar{I_0}$

$\Rightarrow I_1 \bar{I_0} = \Sigma m(2,6)$

$O_3 = \bar{I_2} I_1 I_0 + I_2 \bar{I_1} I_0$

$\Rightarrow I_0 (I_2 \oplus I_1) = \Sigma m(3,5)$

$O_4 = I_2 \bar{I_1} + I_2 I_0 = \Sigma m(4,5,7)$

$O_5 = I_2 I_1 = \Sigma m(6,7).$

$I_2 \backslash I_1 I_0$	00	01	11	10
0				
1	1	1	1 0	0