Question 1

Imagine a gear box created out of the different characters of your first name. For example instead of displaying N for neutral it displays F and instead of displaying R for reverse it displays I and son on. Write a truth table for the seven segment decoder used in this gear box. Your gear box should have the following inputs: P, N, R, and D. From the truth table write the Boolean expressions of the different decoder outputs. **Hint:** look at lecture 16 slide 5.

Question 2

The truth table of a 4 input priority encoder is as follows:

I1	I2	I3	I4	O1	O2
0	0	0	0	X	X
0	0	0	1	0	0
0	0	1	0	0	1
0	0	1	1	0	1
0	1	0	0	1	0
0	1	0	1	1	0
0	1	1	0	1	0
0	1	1	1	1	0
1	0	0	0	1	1
1	0	0	1	1	1
1	0	1	0	1	1
1	0	1	1	1	1
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

1. In few words, explain how the priority encoder works.
2. Using K-map find the simplified Boolean expression of O1 as sum of product.
3. Realize the expression in 2 using two input Nand/Not gates only and count the number of transistors.
4. Using K-map find the simplified Boolean expression of O2 as product of sum.
5. Realize the expression in 4 using Nor/Not gates only and count the number of transistors

A priority encoder outputs the position of the most significant bit of the input.

Question 3

1. Write the Boolean expression of an 8 to 1 multiplexer where S_2, S_1, and S_0 are used for the selection and D_0 to D_7 are the single bit inputs.
2. Write the Boolean expressions of a 1 to 8 demultiplexer where S_2, S_1, and S_0 are used for the selection and D_0 to D_7 are the single bit outputs.
3. Explain what need to be done to transform the above mux/demuxes to accept input/output signals of 8 bits each.

Increase the number of inputs or outputs to 8.

Question 4

In this problem please assume the select input as active high.

1. Continue the following truth table for a 2-to-1 multiplexer, where input1 and input2 are the two inputs to the multiplexer and Sel is the select.

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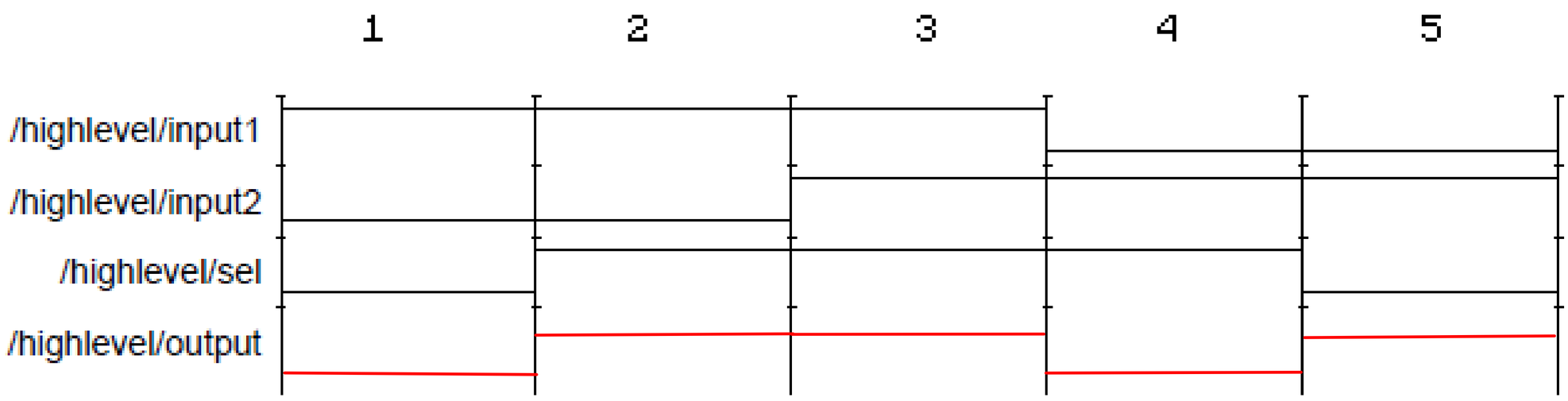
Input1	Input2	Sel	output
0	0	0	0
0	1	0	1
1	0	0	0
1	1	0	1
0	0	1	0
0	1	1	0
1	0	1	1
1	1	1	1

2. Based on this truth table, draw the waveform of the output for the following input waveforms.



Question 5

Continue the truth table for a 1 to 4 demultiplexer:

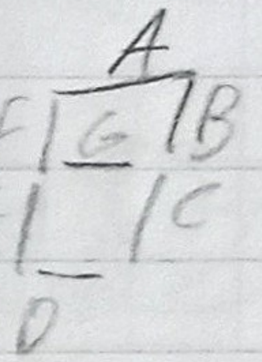
Input	Sel1	Sel2	Output1	Output2	Output3	Output4
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1

Homework 5 active low

Q1)

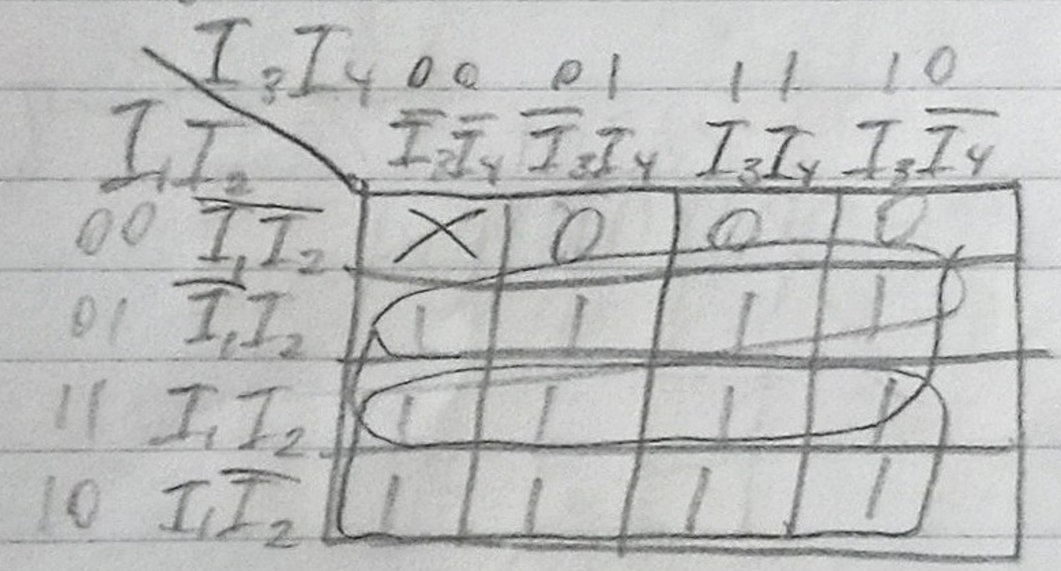
$I_3 I_2 I_1 I_0$	A	B	C	D	E	F	G
1 0 0 0	0	1	1	0	0	0	1
0 1 0 0	0	0	0	0	0	0	1
0 0 1 0	0	0	0	1	0	0	0
0 0 0 1	0	0	0	0	0	0	0

$A = 0$
$B = I_3$
$C = I_3$
$D = I_1$
$E = 0$
$F = 0$
$G = I_3 + I_2$

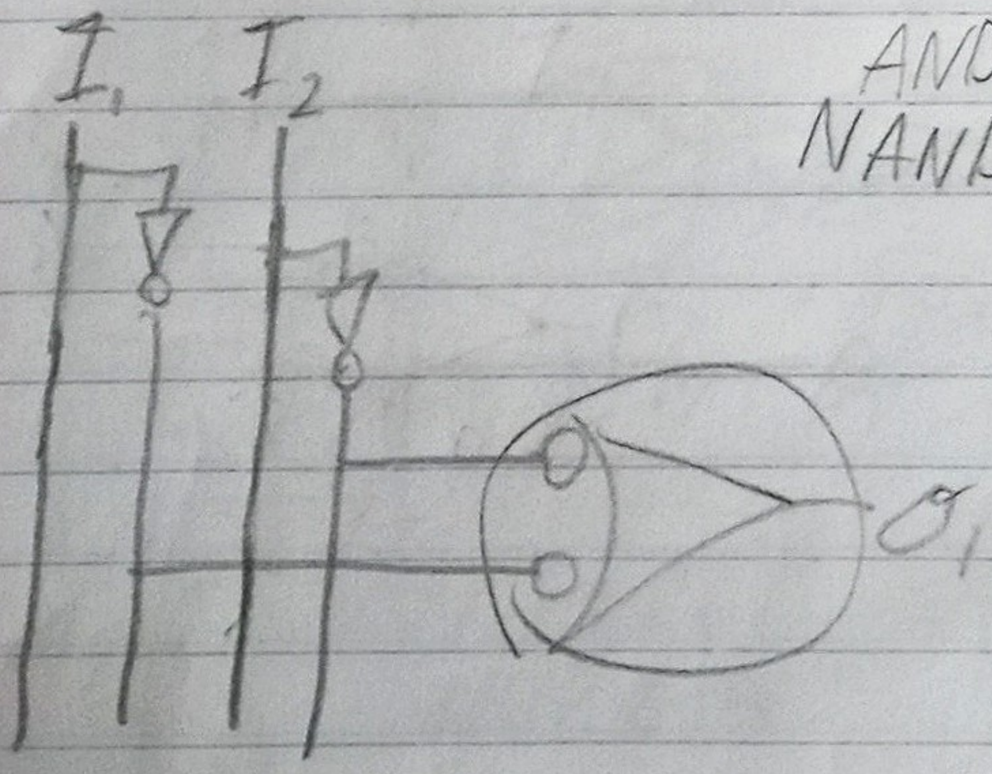


Q2

2)



3) $\boxed{O_1 = \bar{I}_1 + \bar{I}_2}$



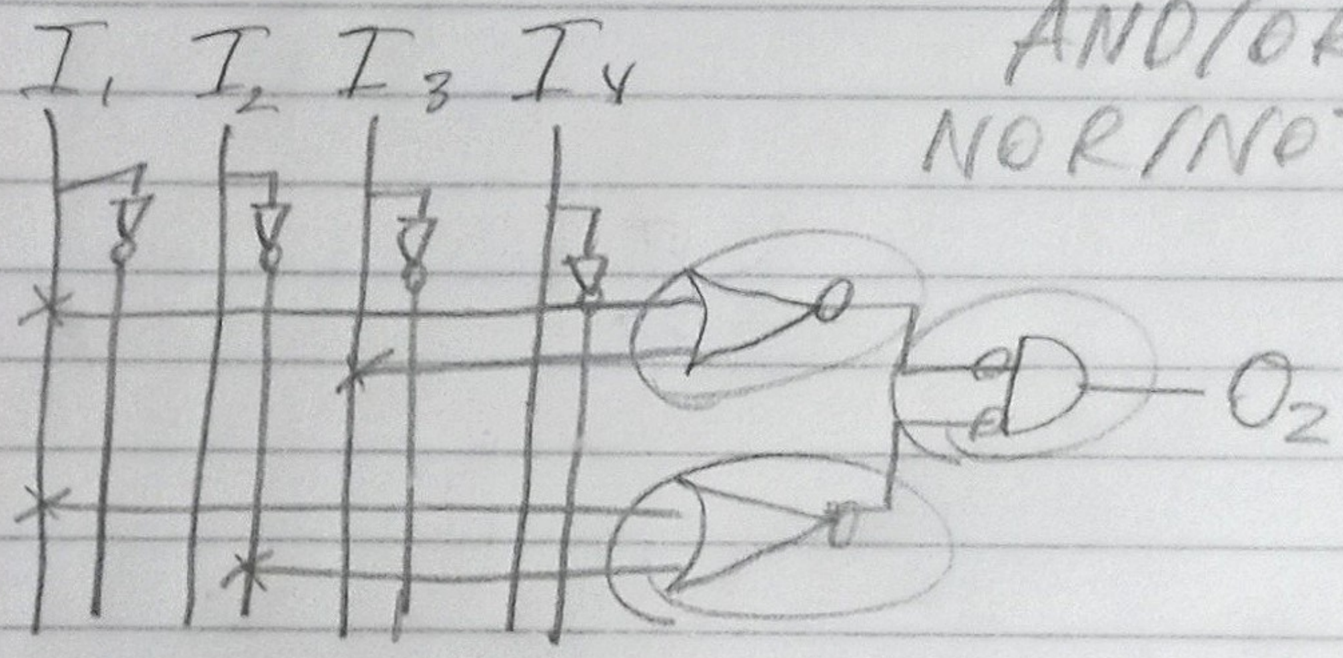
AND/OR = 6 Ts.
NAND/NOT = 4 Ts.

4)

$I_1 I_2$ \ $I_3 I_4$	$\overline{I_3}\overline{I_4}$	$\overline{I_3} I_4$	$I_3 I_4$	$I_3 \overline{I_4}$
$\overline{I_1}\overline{I_2}$	X	0	1	1
$\overline{I_1} I_2$	0	0	0	0
$I_1 I_2$	1	1	1	1
$I_1 \overline{I_2}$	1	1	1	1

$$\overline{y} = \overline{I_3}\,\overline{I_1} + \overline{I_1}\,I_2$$
$$y = (I_3 + I_1)(I_1 + \overline{I_2})$$

5)



AND/OR = 18Ts.
NOR/NOT = 12Ts.

Q3

1) $D_0 = \overline{S_2}\,\overline{S_1}\,\overline{S_0}\,I_0 + \overline{S_2}\,\overline{S_1}\,S_0\,I_1 + \overline{S_2}\,S_1\,\overline{S_0}\,I_2 + \overline{S_2}\,S_1\,S_0\,I_3 + S_2\,\overline{S_1}\,\overline{S_0}\,I_4 + S_2\,\overline{S_1}\,S_0\,I_5 + S_2\,S_1\,\overline{S_0}\,I_6 + S_2\,S_1\,S_0\,I_7$

2) $D_0 = \overline{S_2}\,\overline{S_1}\,\overline{S_0}\,I$
$D_1 = \overline{S_2}\,\overline{S_1}\,S_0\,I$
$D_2 = \overline{S_2}\,S_1\,\overline{S_0}\,I$
$D_3 = \overline{S_2}\,S_1\,S_0\,I$
$D_4 = S_2\,\overline{S_1}\,\overline{S_0}\,I$
$D_5 = S_2\,\overline{S_1}\,S_0\,I$
$D_6 = S_2\,S_1\,\overline{S_0}\,I$
$D_7 = S_2\,S_1\,S_0\,I$

3) Increase the number of inputs or outputs to 8.