National University of Sciences and Technology (NUST)
School of Electrical Engineering and Computer Science

Department of Electrical Engineering

Faculty Member: Sir Arshad Nazir **Dated: 28-09-2023**

Semester:3rd **Section:BEE-14-D**

Group No.:10

EE-221: Digital Logic Design

Assessment Rubrics for Lab No # 3: Design of Simple Practical Circuits

		PLO4/CLO4	PLO4/CLO4	PLO5/CLO5	PLO8/CLO6	PLO9/CLO7	
Name	**Reg. No**	**Viva / Lab Performance** **5 Marks**	**Analysis of data in Lab Report** **5 Marks**	**Modern Tool Usage** **5 Marks**	**Ethics and Safety** **5 Marks**	**Individual and Team Work** **5 Marks**	**Total marks Obtained** **25 Marks**
Ahmed Nasir	**409959**						
Arooj Fatima	**423365**						
Haseeb Umer	**427442**						
Irfa Farooq	**412564**						

Lab No 2 : Digital Design of Simple Practical Circuits

Prelab:

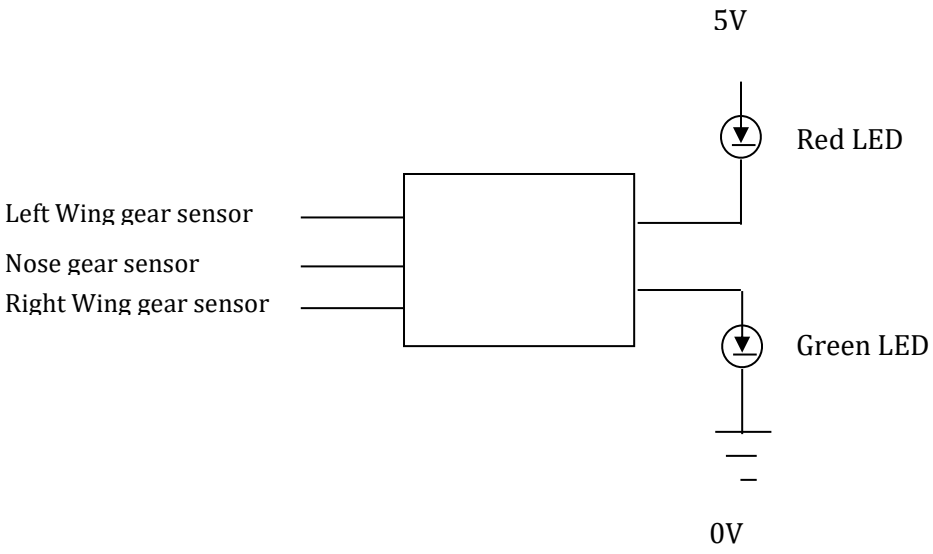
1. Design the practical circuits given in Task 1 and Task 2 by giving the truth table of the problems and then giving the circuit (logic diagram) for the designs
2. Provide only Truth Table of Task 3.

Lab Tasks:

Practically demonstrate the Task 1 circuit in the lab. Upload the lab report giving all the steps and circuit implementation

Task No 1

As part of an aircraft's functional monitoring system, a circuit is required to indicate the status of the landing gear prior to landing. A green LED (Light Emitting Diode) display turns on if all three gears are properly extended when the "gear down" switch has been activated in preparation for landing. A red LED display turns on if any of the gear fails to extent properly prior to landing. When landing gear is extended, its sensor produces a HIGH voltage. When a landing gear is retracted its sensor produces a LOW voltage. Write the truth table for the aircraft landing system. Implement with basic logic gates.



Logic Circuit

Truth Table:

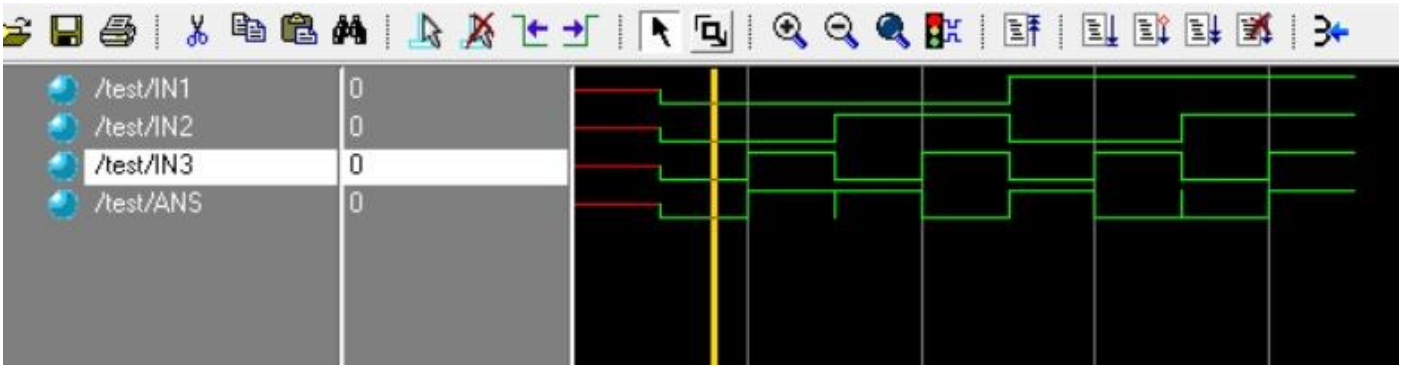
Left Wing gear sensor: A
Right Wing gear sensor: B
Nose gear sensor: C

A	B	C	Green light	Red light
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0

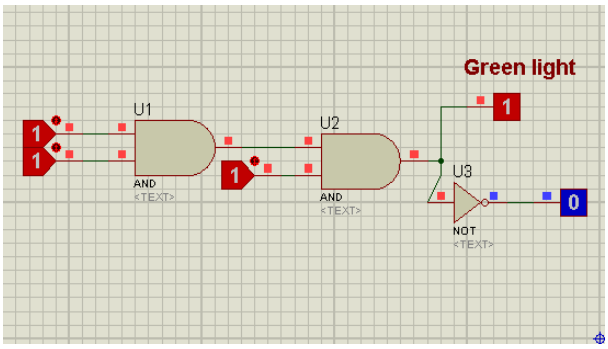
Design and Stimulus Code:

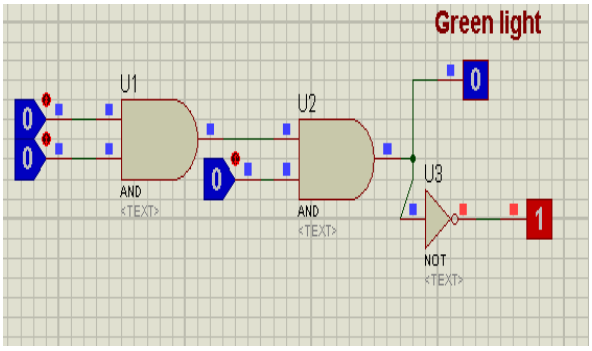
```
ln #
 1 module circuit ( green, red, in1, in2, in3);
 2 input in1,in2,in3;
 3 output green,red;
 4 assign green = ( in1 & in2) & in3;
 5 assign red = ~ ( ( in1 & in2) & in3);
 6 endmodule
 7
 8 module test;
 9 reg IN1, IN2, IN3;
10 wire GREEN, RED;
11 circuit test1 ( GREEN, RED, IN1, IN2, IN3);
12 initial
13 begin
14 # 100 IN1=1'b0;IN2=1'b0; IN3= 1'b0;
15 # 100 IN1=1'b0;IN2=1'b0; IN3= 1'b1;
16 # 100 IN1=1'b0;IN2=1'b1; IN3= 1'b0;
17 # 100 IN1=1'b0;IN2=1'b1; IN3= 1'b1;
18 # 100 IN1=1'b1;IN2=1'b0; IN3= 1'b0;
19 # 100 IN1=1'b1;IN2=1'b0; IN3= 1'b1;
20 # 100 IN1=1'b1;IN2=1'b1; IN3= 1'b0;
21 # 100 IN1=1'b1;IN2=1'b1; IN3= 1'b1;
22 end
23 endmodule
```

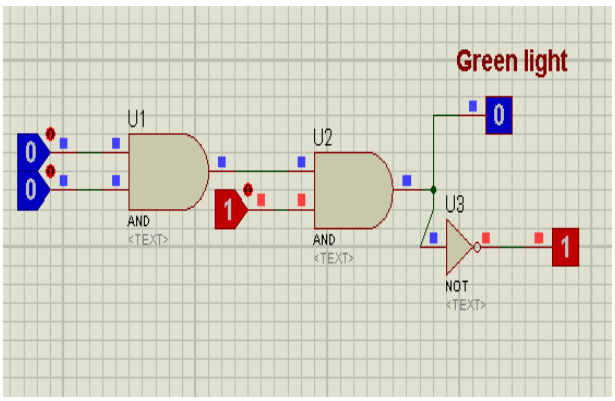
Modelsim Output Wave:

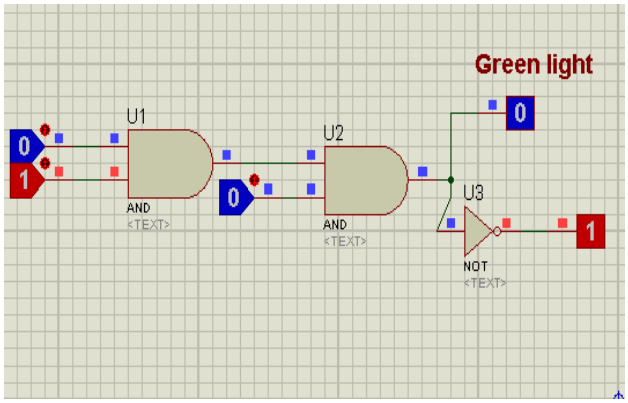


PROTEUS Simulation:

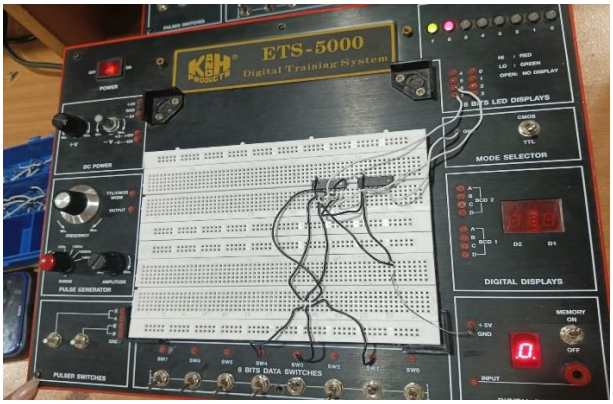


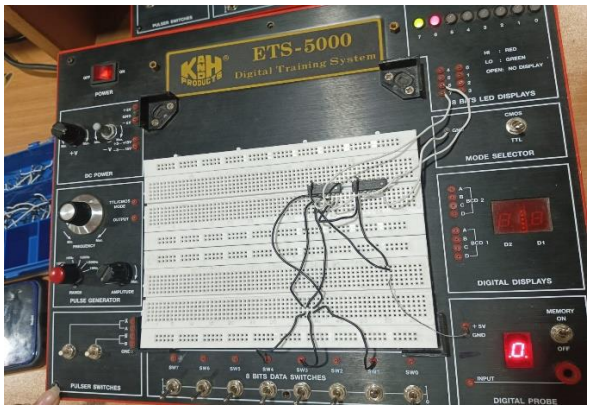


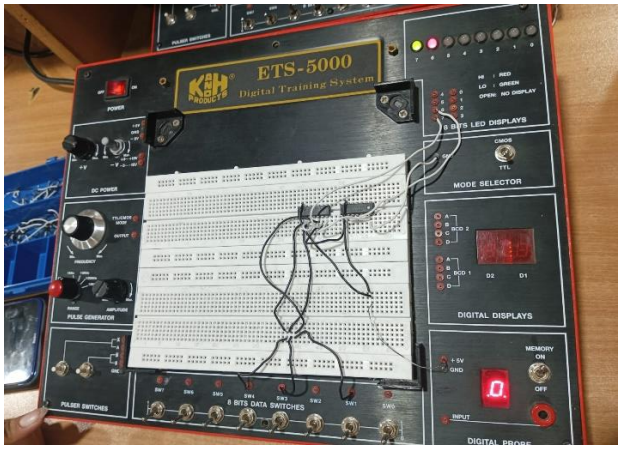


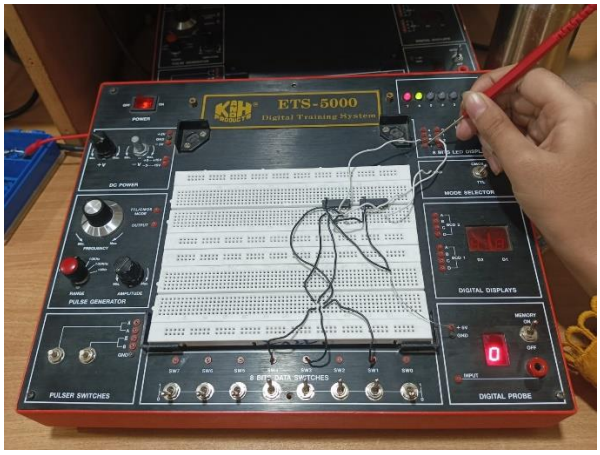


Hardware:









Task No 2

Design a three-way switch for lighting a bulb. Suppose the Switch A is installed at the entrance of the room, switch B is installed to the bedside table, Switch C is installed outside the room. Now three way switching can facilitate the switching ON/OFF from any location. The mechanism is such that if a single switch is on the bulb should be ON. Now if the second switch is turned on the bulb if switched on earlier is switched off. If two switches are already on and third switch is turned on then it should switch on the bulb. Implement with basic gates.

Truth Table :

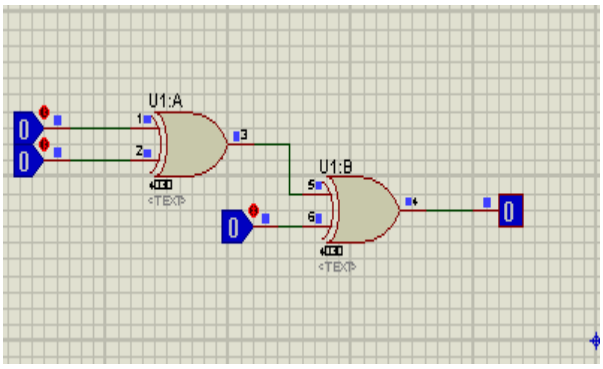
Switch A	Switch B	Switch C	Blub
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

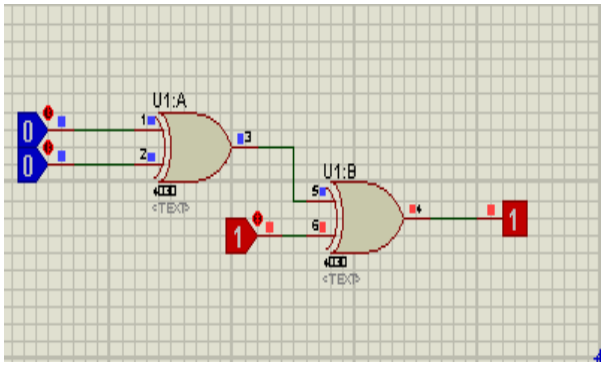
Design and Stimulus Code:

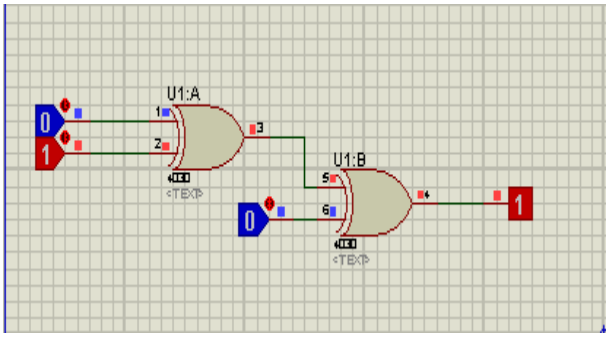
```
module circuit ( ans, in1, in2, in3);
input in1,in2,in3;
output ans;
assign ans = (( in1 ^ in2) ^ in3);
endmodule

module test;
reg IN1, IN2, IN3;
wire ANS;
circuit test1 ( ANS, IN1, IN2, IN3);
initial
begin
# 100 IN1=1'b0;IN2=1'b0; IN3= 1'b0;
# 100 IN1=1'b0;IN2=1'b0; IN3= 1'b1;
# 100 IN1=1'b0;IN2=1'b1; IN3= 1'b0;
# 100 IN1=1'b0;IN2=1'b1; IN3= 1'b1;
# 100 IN1=1'b1;IN2=1'b0; IN3= 1'b0;
# 100 IN1=1'b1;IN2=1'b0; IN3= 1'b1;
# 100 IN1=1'b1;IN2=1'b1; IN3= 1'b0;
# 100 IN1=1'b1;IN2=1'b1; IN3= 1'b1;
end
endmodule
```

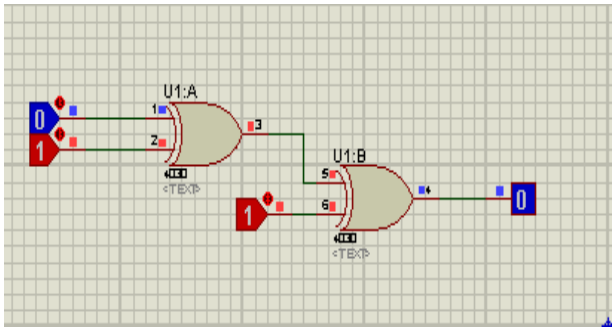
Modelsim Output Wave:

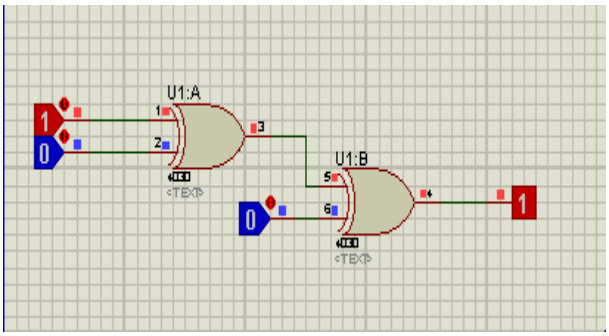
PROTEUS Simulation:

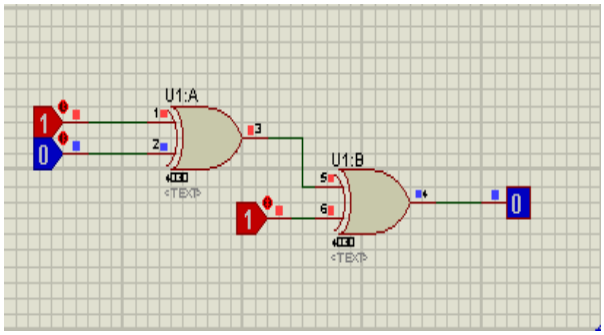


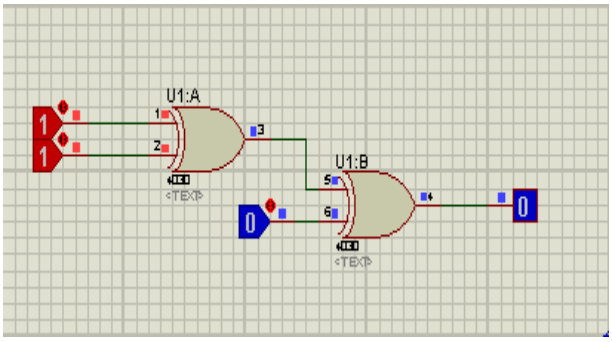


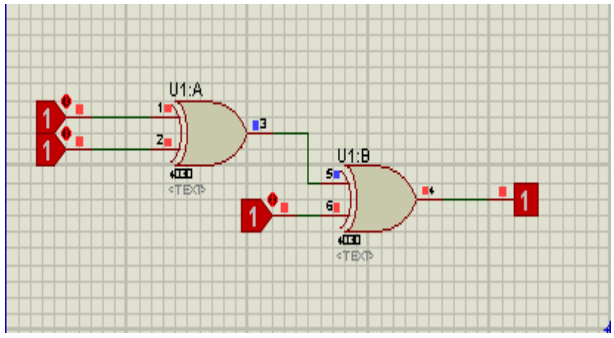












Hardware:

Task No 3

The system is a speed warning device. It receives, on two lines, an indication of the speed limit on the highway. There are three possible values 45, 55, or 65 MPH. It receives from the automobile, on two other lines, an indication of speed of the vehicle. There are four possible values under 45, between 46 and 55, between 56 and 65, and over 65 MPH. It produces two outputs. The first f, indicates whether the car is going above the speed limit. The second g, indicates that the car is driving at “dangerous speed” – defined as either over 65 MPH or more than 10 MPH above the speed limit. Show how each of the inputs and outputs are coded (in terms of binary values) and complete the truth table for the system.

Solution:

Speed Limit (SL):

00: 45 MPH

01: 55 MPH

10: 65 MPH

Vehicle Speed (VS):

00: Under 45 MPH

01: Between 46 and 55 MPH

10: Between 56 and 65 MPH

11: Over 65 MPH

Output f (Above Speed Limit):

0: Car is not going above the speed limit

1: Car is going above the speed limit

Output g (Dangerous Speed):

0: Car is not driving at dangerous speed

1: Car is driving at dangerous speed

Truth table:

SL	VS	F	g
00	00	0	0
00	01	1	0
00	10	1	1
00	11	1	1
01	00	0	0
01	01	0	0
01	10	1	0
01	11	1	1
10	00	0	0
10	01	0	0
10	10	0	0
10	11	1	1
11	00	X	X
11	01	X	X

11	10	X	X
11	11	X	X

$$X = \text{Don't Care}$$

Conclusion:

We have performed following three tasks in this lab

Task 01: Aircraft Landing Gear System

- Green LED indicates all three gears properly extended
- Red LED indicates any gear failure to extend
- Implemented with basic logic gates
- Truth table created for system operation

Task 02: Three-Way Switch for Bulb

- Switches A, B, and C for versatile control
- Single switch activates bulb, second switch deactivates, third switch reactivates
- Implemented using basic gates for practical application

Task 03: Speed Warning Device

- Inputs: Speed limit and vehicle speed indications
- Outputs: f for exceeding speed limit, g for dangerous speed
- Coded inputs and outputs in binary values
- Truth table completed for system operation

Overall, tasks demonstrated application of digital logic principles in real-world scenarios. Each task showcased efficient use of basic logic gates for functional electronic systems. This lab has provided valuable hands-on experience in digital logic design for engineering applications