ONLINE TRAINING PHASE-TASK 3

TASK 3.1:

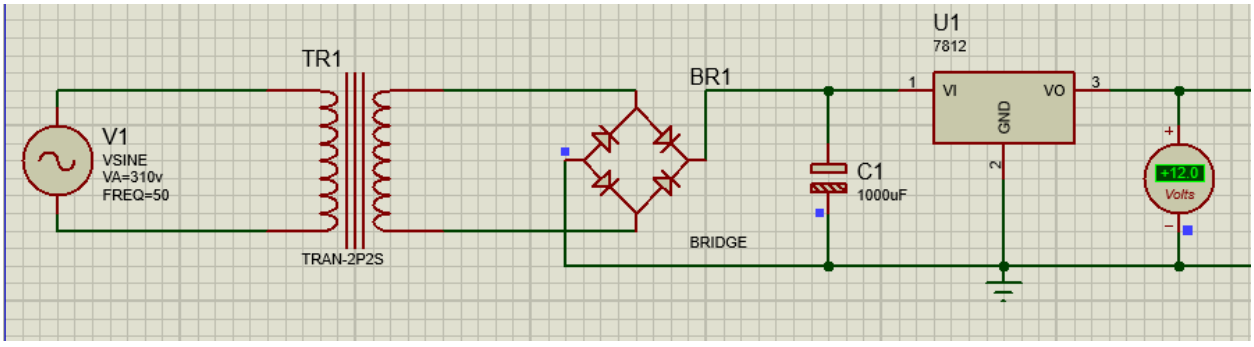
STEP-DOWN TRANSFORMER

It was required to design a step-down voltage rectifier that converts from 220V AC to 12V DC. At first, we need 220V AC and 50 Hz frequency voltage source to supply the circuit, then the output of the AC voltage source should be stepped down by a step-down transformer (220V – 24V).

Setting the transformer by getting the turns' ratio N1/N2 = 220/24 = 9.167. Let the primary inductance equals to 1H then, to get the secondary inductance needed to satisfy the operation is L2 = 1 / (9.167^2) = 0.01189H.

Using full-wave rectifier which convert AC voltage to pulsating DC voltage and then, it's followed by a capacitor with large capacitance to decrease the ripple voltage and get relatively constant voltage.

To get exactly DC 12V we use regulator (7812) after getting the output of the full-wave rectifier. By using DC voltmeter, we made sure that the output of the regulator and the circuit is 12V DC-voltage.

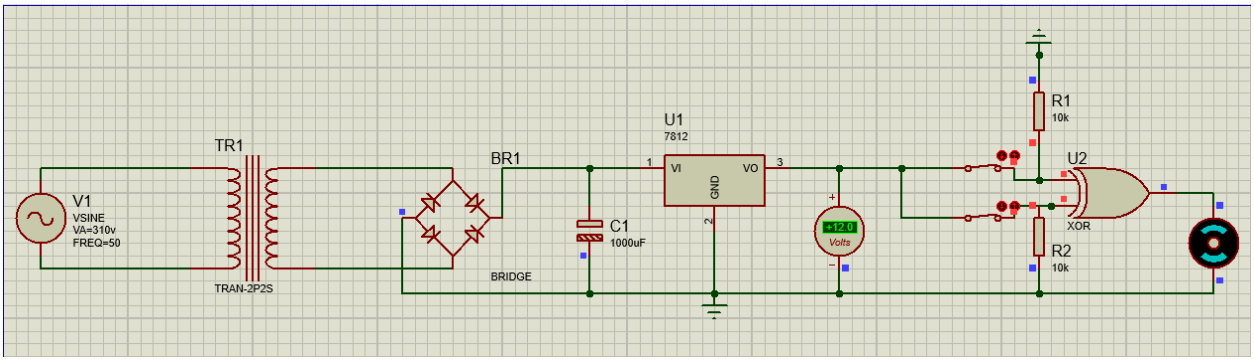


As an application on the previous circuit, we need to use it to control a vacuum door using two switches. You can open the door from one switch and close from the other one and vice versa. Also, you can open and close using the same switch.

Connecting the two switches to the output of the previous circuit. To prevent the floating situation, we use pull down resistance on each switch connected to the ground.

To implement the desired logic of the two switches, use XOR gate which provides opening the door from one switch and close from the other one and vice versa. Also, you can open and close using the same switch.

We've used the DC motor to represent the door action. Connect the output of the XOR gate to the motor.



TASK 3.2:

SIMPLE COMMUNICATION SYSTEM

It's desired to design a simple digital communication system between the astronaut and the spaceship. Where the astronaut has three push buttons to send his status to the spaceship. The spaceship has two LED lights which're LED 1 and LED 2. There're some conditions related to the communication between the astronaut and the spaceship which are LED 1 ON and LED2 ON when the red button is pressed, LED 1 ON and LED 2 OFF when the green button is pressed, LED 1 ON and LED 2 ON when the blue button is pressed, two LEDs are OFF when there are no buttons are pressed and LED 1 OFF and LED 2 ON when the green and blue or the green and red are pressed.

Making a truth table eases the operation a lot, 'X' refers to don't care situation:

RED	GREEN	BLUE	LED 1	LED 2
0	0	0	0	0
0	0	1	1	1
0	1	0	1	0
0	1	1	0	1
1	0	0	1	1
1	0	1	X	X
1	1	0	0	1
1	1	1	X	X

Also using Karnaugh-map provides standard SOP equation, we'll use two Karnaugh-maps for each LED:

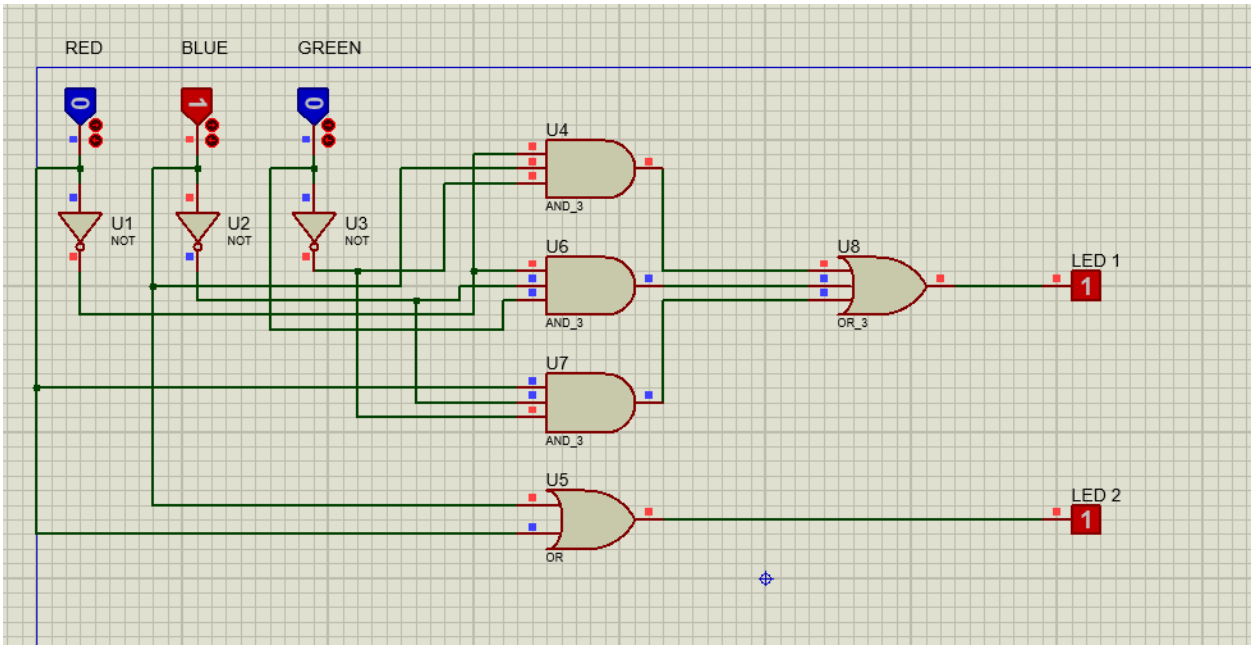
BLUE		0	1	
RED GREEN	0 0	0	1	
	0 1	1	0	LED 1
	1 1	0	X	
	1 0	1	X	

BLUE		0	1	
RED GREEN	0 0	0	1	
	0 1	0	1	LED 2
	1 1	1	X	
	1 0	1	X	

From the previous Karnaugh-maps, we got the standard SOP of both LEDs:

LED 1 = BLUE !RED !GREEN + !BLUE !RED GREEN + !BLUE RED !GREEN

LED 2 = BLUE + RED


RED
BLUE
GREEN
0
1
0
U1
NOT
U2
NOT
U3
NOT
U4
AND_3
U6
AND_3
U7
AND_3
U5
OR
U8
OR_3
LED 1
1
LED 2
1

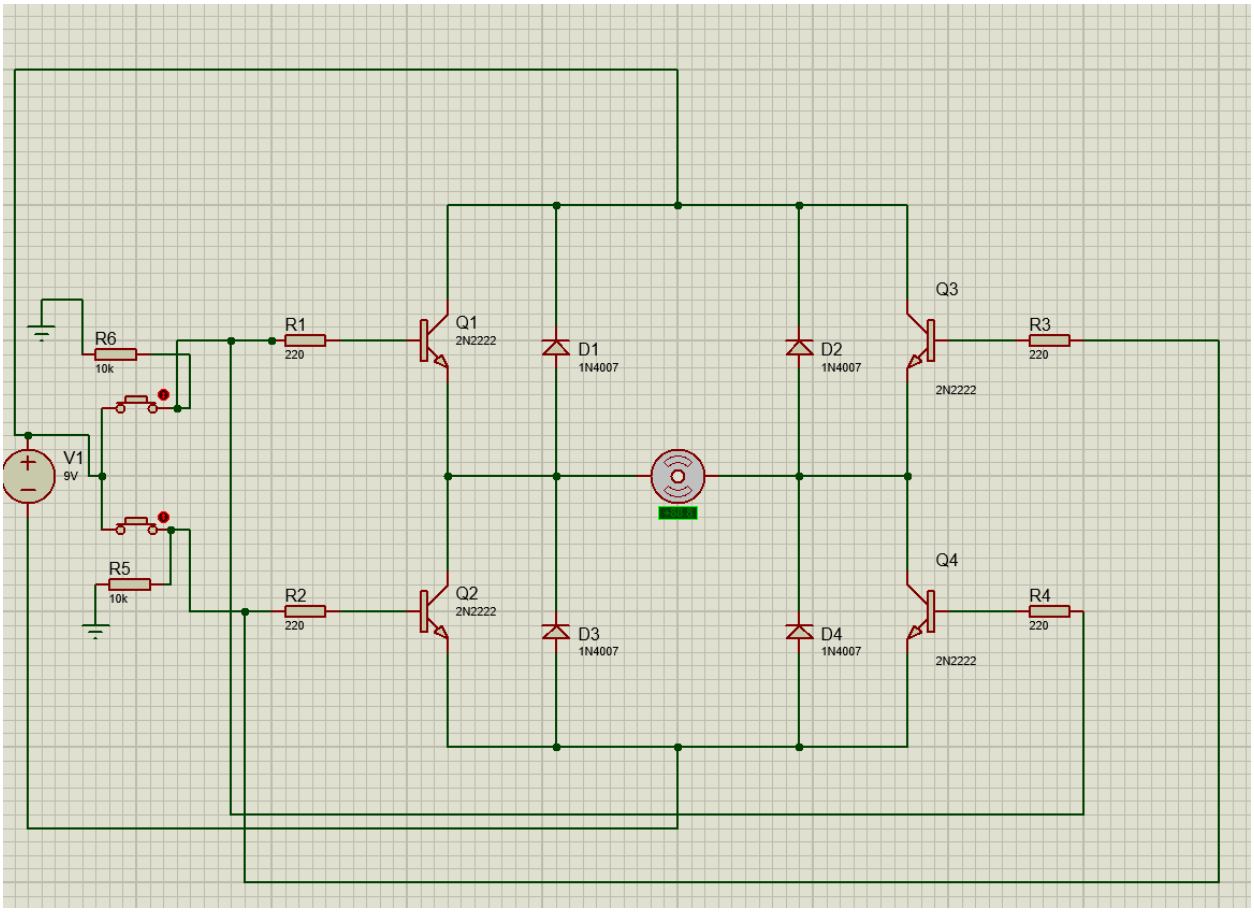
TASK 3.3:

CONTROL DIRECTION OF MOTOR

It's desired to design a simple circuit using a suitable type of transistor to control the direction of a 15 A motor. Using just four transistors.

At first, thinking like it's path switch by using 4 transistors as each 2 diagonal transistors are connected. Connecting two push buttons to each connection of transistors as if the button is pushed then this path is closed and the motor works in such direction and vice versa.

Using H- bridge for switching and controlling the motor was useful. The H-bridge is an electronic circuit that looks like the letter H. An H – bridge is used to drive the load to the motor.



ANSWER TO QUESTION 1: BJT transistor to switch between the 2 paths.

ANSWER TO QUESTION 2: No.

TASK 3.3:

BATTERY CONNECTION

Supply a device with 6A and 12V MAX. I've used 4 batteries of 6 volts each 2 are series then parallel.