# TEJ3M Electronics Culminating Project

This project will combine all your knowledge of logic gates, truth tables, and breadboarding (prototyping)

You will be provided with several challenges (of different difficulty levels), and the one you choose to solder as your final project will be the final project that is assessed.

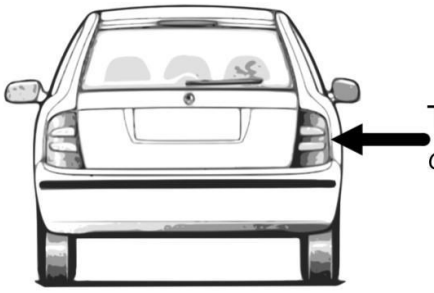
Regardless of which project you choose, your report must include the following:

- An outline explaining which project your chose to create and its requirements
- Upload an image file of your LOGISIM circuit diagram within your report as well as the circuit file (extension .circ) to the Google Classroom post. Remember that if there are two inputs, you would have four possibilities in total.
- Breadboard view of your circuit (Choice # AND the modification) using Tinkercad (take a screenshot of the completed circuit - you will need two circuits in total)
- Shared link of your two Tinkercad circuits (Click on SHARE > Invite People > Copy). Paste the links within your report. You need to share both circuits: the original circuit and the modification circuit. Give both a different name in Tinkercad and remember to save your work.
- Boolean expressions that represent the behaviour of your circuit. Each output LED needs to have its own equation.
- Truth tables for your circuit organized in a table with all input(s) and output(s)
- Modification Rationale and Testing: Explain how your addition to the circuit works and why you chose to add certain components (e.g. extra logic gates, other components, etc). Why do you think your solution is optimal? Explain this in a paragraph that is well organized within your report. Discuss any troubleshooting steps you did and how you overcame issues throughout this assignment.

**Choice 1** (Max of 80 % on Knowledge, Thinking and Application if you choose this one. It is easier than choice #2)
Create a "wannabe" traffic light using three LED's, two switches (you can use the DIP switch), and logic gates. The red LED should turn on when both switches are on; the yellow LED should turn on when exactly one of the switches is turned on; and the green LED should turn on when both switches are turned off. Only one light should be on at any given time.

*Modification:* Add one more gate to your circuit to turn off the whole system. This means that all LED's stay OFF and do not change at all when the circuit will shut off. When the component is pressed or altered again, the circuit will act as normal. You will need another input as well to do this.

**Choice 2** (*This one is more difficult*)
Create the rear turning lights and brake light system for a car. Your system will account for a turn signal (either left or right) and a brake signal. There will be three inputs and three LED's (2 turning lights (on the



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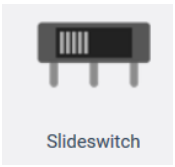
rear left and right side of the car) and one brake light in between the two turning lights).

The brake must always override the turn signal and cause all three lights to turn on.
The Left turn signal must cause the left rear light to turn on, and leave the right rear light off.

The Right turn signal must cause the right rear light to turn on, and leave the left rear light off.

In reality, a driver cannot press the left and right turning buttons at the same time but this can be done in your circuit when you finish wiring it. In order to avoid this scenario, use the slideswitch component in Tinkercad. 

Do some research and see if you can figure it out.

This removes all of the possibilities where both turning buttons can be pressed as this is not a realistic possibility. You need to activate the slideswitch first before one of the turn signals will start working.

**Modification #1: (**Max of 90% on KU, APP and T/I)
Add a fourth input that simulates turning OFF and the ON the car. When the input is OFF (0 in binary), all of the lights will stay off. When the input is high (1 in binary), the circuit behaves as normal.

***Modification #1 AND NEW REQUIREMENT*** (Do this one for a max of 100% on this assignment overall)
In addition to modification #1: Add a 555 timer to cause one of the turn signals to blink when the turning signal button is pressed, instead of solely turning it on. Remember that the brake lights should not blink, but remain steady.

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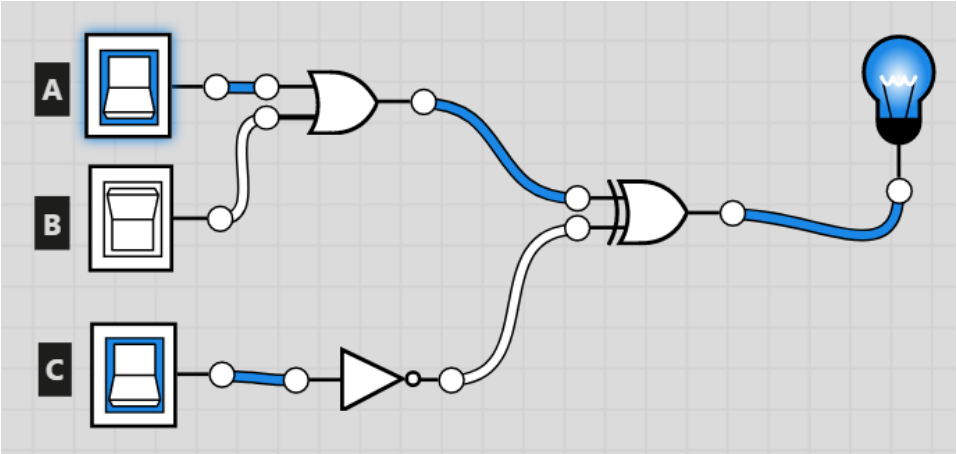
**Examples:**

A Logic Diagram (You will need one for each scenario)




Marking Scheme:

| Criteria | Mark | | | | |
|---|---|---|---|---|---|
| **Truth Table** for circuit correctly completed (pre-modification) **(K)** | 5 | 4 | 3 | 2 | 1 |
| **Truth Table** for circuit correctly completed (modification) **(K)** | 5 | 4 | 3 | 2 | 1 |
| **Boolean expression** is correct for the entire circuit with the modification **(K)** | 5 | 4 | 3 | 2 | 1 |
| **Logic Diagram Pictures** show all possibilities and mirrors the truth table **(K)** | 5 | 4 | 3 | 2 | 1 |
| **Logic Diagram Pictures** show all possibilities and mirrors the truth table for the original circuit and the modification **(K)** | 5 | 4 | 3 | 2 | 1 |
| **Choice 1 or 2 (pre-modification)** circuit is working correctly **(A) Max 8 / 10 for choice 1** | 10 | 8 | 4 | 2 | 1 |
| **Modification** circuit connected and operating correctly **(A) - max of 8 if you wire choice #1** | 10 | 8 | 4 | 2 | 1 |

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|---|---|---|---|---|---|
| Correct use of LEDs and resistors to show operation visually for all circuits. The component locations and appearance of components mimic the real life situation well. Your circuit is easy and straightforward to test (A) - max 4 /5 if you did choice #1 | 5 | 4 | 3 | 2 | 1 |
| **Circuit layout / Appearance (planning step)** is exceptionally neat, uses minimal wire length (where possible) and always follows colour code conventions (red for wires directly connected to POWER (+6v rail), black for GROUND and different colours for all other connections within the circuit **(T)** | 5 | 4 | 3 | 2 | 1 |
| **Modification Rationale (T):** Explanation clearly outlines how the modification works and why you chose it. The rationale is clear and you have shown excellent planning skills in testing and correcting your circuit's operation. General approach to adding in the modification appropriately and effectively. | 5 | 4 | 3 | 2 | 1 |
| **Neatly completed report.** All circuit diagrams correctly labeled and all truth tables neatly completed. All sections have a clear heading that is bolded and underlined. No information is omitted. **(C)** | 10 | 8 | 4 | 2 | 1 |
| **Total** | **/ 70** | | | | |