Individual Technical Mission

Low Voltage

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1. You are given two AVR microcontrollers

AVR 1 and AVR 2

AVR 1 is connected to two push buttons PB_1, PB_2, and PB_3

AVR 2 is connected to an H-Bridge and a DC motor

The two AVRs are also connected to each other.

You are required to:

a) Write a program that uses **UART communication** to achieve the following:

If PB_1 is pressed, then the motor turns clockwise

If PB_2 is pressed, then the motor turns the anti-clockwise

If PB_3 is pressed, then the motor turns off

b) Create a simulation of this circuit using any simulation program (such as proteus for example)

- Record a video of the simulation while it's running and press each push button to show their different actions in real time.
- Add this video to a zip or RAR folder with the rest of your answers.

➢ ***answer.***

https://www.mediafire.com/file/qohszoeuavlvou0/ACU_Racing_Team.rar/file

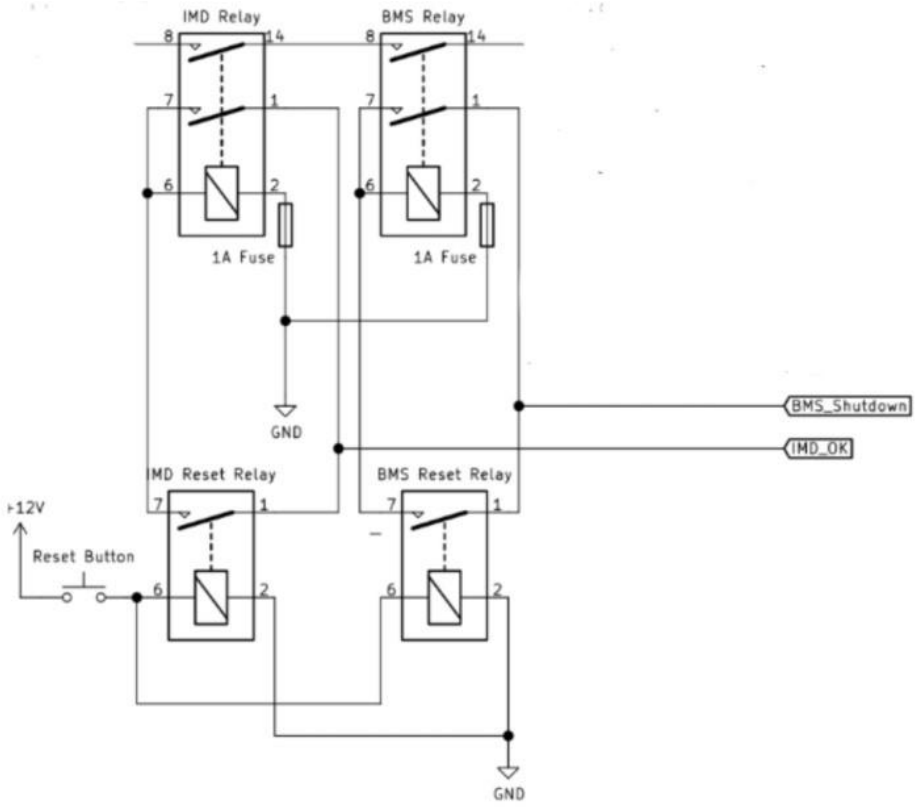
2. What could be the output of this program? explain why?

```c
#include <stdio.h>
#include <stdlib.h>
#include <stdint.h>

int main(void)
{
    int32_t RT_TEMP[8] = {0};
    RT_TEMP[0] = (int32_t)0x24364892;
    uint8_t *RT_U8= &RT_TEMP[0];
    printf("%x", RT_U8[0]);

    return 0;
}
```

- OUTPUT → 00000092
- EXPLAIN → unsigned number

3. This is a snip of the shutdown circuit of the car if the BMS_Shutdown signal and IMD_OK signal is high

And you push the pushbutton and then release your finger will the BMS relay and IMD relay be open or closed and why?



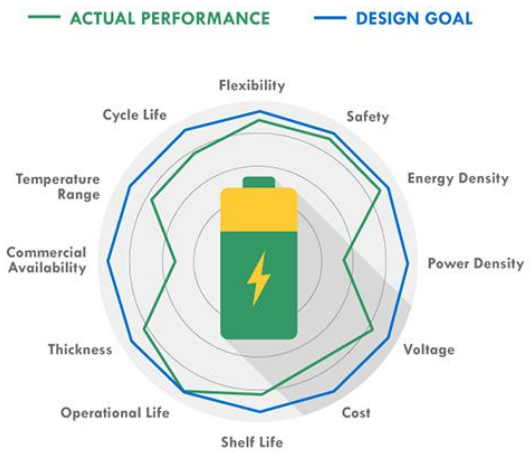
➔ Closed

➔ Why ?

Pressing the push button leads to the lock of the two relays to the bottom, because the relays act as if they are switches. Every volt entered, the circuit is locked, its input is 12 volts, and the BMS relay and IMD relay will also be locked because it entered a signal high, so the circuit is locked.

4. If you want to choose a battery to supply all the components in the car what is the main method or what criteria will you choose the battery based on?

- ***answer.***



1- Primary vs. Secondary.

1-Primary batteries : **(single way)**
A much lower self-discharge rate is an attractive feature when charging is not possible or worked before first use.
2- Secondary batteries: **(multi way)**
to a higher rate of energy loss. This is less important in most applications due to the ability to recharge.

2- Energy vs. Power.

3- Voltage.

4- Temperature range.

5- Shelf life. (مدة الصلاحية)

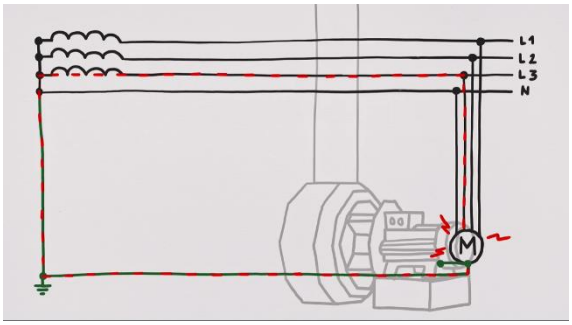
6- Physical size and shape.
(يعني مثلا مش بطارية لعب اعمل ليها بطارية مثل بطارية السيارة)

7- Cost.

5. talk about the functionality and importance of these parts:

1. *Insulation Monitoring Device* :

(A device that detects errors and the amount of deterioration and where this error occurs)



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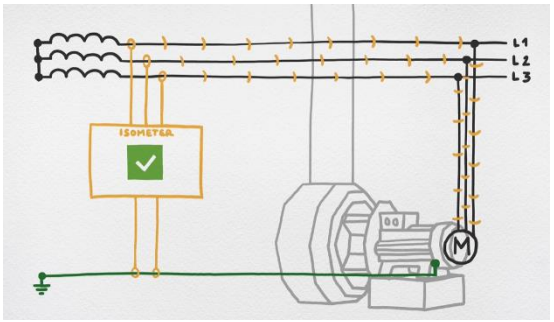

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2. *Accumulator Isolation Relay* :

Relays can reduce the need for high-voltage wiring and switches, which are expensive and take up space **(they convert low currents into high currents)** allowing manufacturers to install more functions in a space of the same size.
It is used as switches to obtain low currents from high currents and vice versa, such as **(they are used in car headlights to convert from strong and weak light and lock them).**

3. *Brake over travel switch :*

Brake over travel (BOT) switch is additional safety feature in a car.
BOT switch works as kill switch in condition of brake system failure.
BOT switch is ordinary normally open switch. Which does not flow current in its normal state.
BOT switch is fitted behind the brake paddle in pulled up condition i.e. closed circuit . This switch is placed in such a way that brake paddle does not touch the BOT switch even in case of panic braking. BOT switch comes into action when there is any leakage or air in the brake lining. Due to excessive travel of brake paddle this switch is hit by brake paddle to go into it's normal condition. When BOT switch returns in this position it turns engine off and cut the supply of current from major components of vehicle like fuel pump, ECU etc. This is how Brake Over Travel Switch works.
As the name implies brake on key travel. Assume that if the brake pedal is lowered or exceeded, the brakes fail to work. This can be caused by completely worn brake pads, broken brake lining, or oil leaks from the disc brakes. In this case, the pedal moves further and the BOT switch is pressed, it disconnects the ignition circuit and the engine turns off until the breaks are fixed. This kind of safety feature.

4. *Inertia switch :*

The switch is intended to disable the electric fuel pump in automotive applications. This function is required on some motorsport applications, where the electric fuel pump may continue to operate after a collision or rollover. If the fuel line breaks or the vehicle reverses, the fuel may spill, resulting in a fire. A small loose weight (called a proof block) is held inside a spring-loaded cage. A shock in any direction will cause the mass to move relative to the cage. In the event of sufficient shock, a cage that operates a keyed switch will open. The switch is reset by pressing the cage closed through the flexible top cover (red), and reassembling the block. These switches are also used to open a conductor (large relay) to disable the high power circuit of a battery electric vehicle in the event of a collision.

6. *What are the main electric systems components in ICE Cars? What is the role of the electric system in starting the engine?*

1. Power Generator - Alternator / Dynamo: It generates electricity, drawing power from the engine. It generates enough power to meet all the requirements of all the electrical components in a car.

2. Power Bank - Battery: It supplies power to start the car. Also, supplies power to various equipments when generator is not able to provide enough power e.g. playing car radio with engine off or heavy duty lamps and air-con at idle rpm.

3. Engine firing - Ignition Coil / Fuel pump switch: Petrol (Gasoline) engines need spark to fire (or burn the fuel) the cylinder. For diesel engine, the pump has to be kept on - which is usually done by a solenoid switch, to keep injecting fuel into the engine to keep it running.

4. Cooling Fans: In earlier days, the cooling fans (radiator fan) were coupled with engine. But with front wheel drives and advancements, the cooling fans are controlled electronically i.e. they are switched on when there is a requirement using a thermostat. The fans run on electricity.

5. Air-Con Blower: This is another fan responsible for circulating from air-con to car cabin.

6. Lighting - Head Lamps, Tail Lamps, Blinkers, Brake Lights etc: They are wired on a central circuit running throughout the car.

7. Motor / Actuators - Wiper, Power Window etc: The are used to carry out various functions in the car including controls for side (wing) mirrors.

8. On-Board Computer - ECU: It is the Electronic Control Unit, managing various functions in the car.

9. Fuse Box / Relays: They manage current in the car. Fuses prevent the electrical equipments from frying in case of faulty alternator, wiring etc. Relays do the switching of heavy electrical items in the car.

10. Combination Switch: It is the switch assembly that sits under the steering wheel and used to control various things like head lights, wipers etc.

11. Peripherals Systems - like stereo, clocks, cabin lights, trunk lights.

12. Signal Transmission: Today cars run on electronics which involve a range of sensors, transmitters etc for tyre pressure, crash sensing, oil levels etc.

13. Wiring.

14. Starter Motor: It is responsible for cranking the car to start the engine. It draws power from battery.

Note: The electrical systems are very complex these days, even the throttle is electronically controlled and so is the fuel quantity to the engine. Cars today are fitted with too many electrical systems like LED screens, SatNav etc. Even the ABS works using electricity.

7. *Make a comparison between the old ignition system and the new one?*

Old ignition system

Compression ignition Diesel engines ignite the fuel-air mixture by the heat of compression and do not need a spark. They usually have glowplugs that preheat the combustion chamber to allow starting in cold weather. Other engines may use a flame, or a heated tube, for ignition. While this was common for very early engines it is now rare.

Compared to late-model vehicles, old car ignition systems are fairly simple to understand and diagnose. They are comprised of two circuits, the primary (low-tension) side, and the secondary (high-tension) side.

Low-Tension Side
Your old car ignition system starts with the battery, then on to the ignition switch, contact breaker (points), and the primary windings of the coil. These are all part of the low-tension circuit. The key-operated ignition switch connects and disconnects power to the ignition and electrical system.

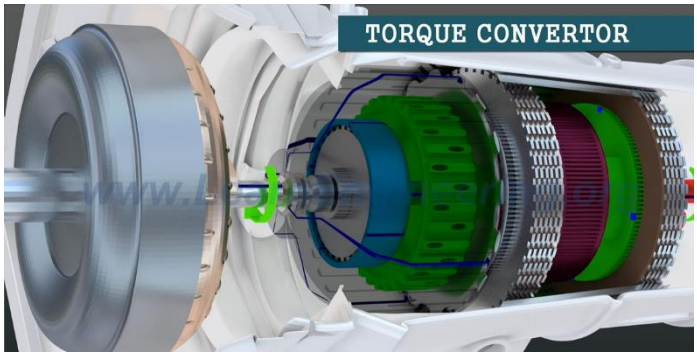
High-Tension Side
The high tension side of the ignition system includes the distributor cap and rotor, spark plugs, spark plug wires, and the secondary winding of the coil. In a 12 volt system, the 12 volts from the primary side go into the coil, and come out at over 20,000+ volts.

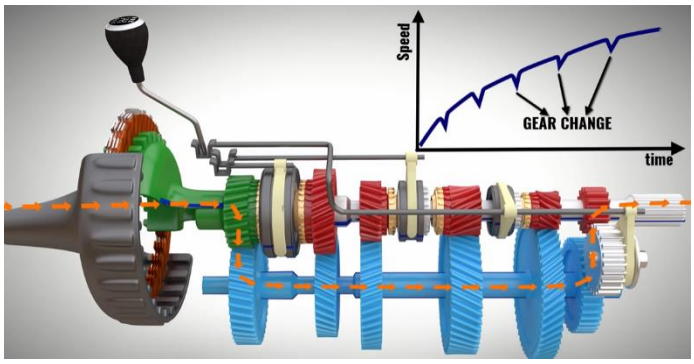
New ignition system

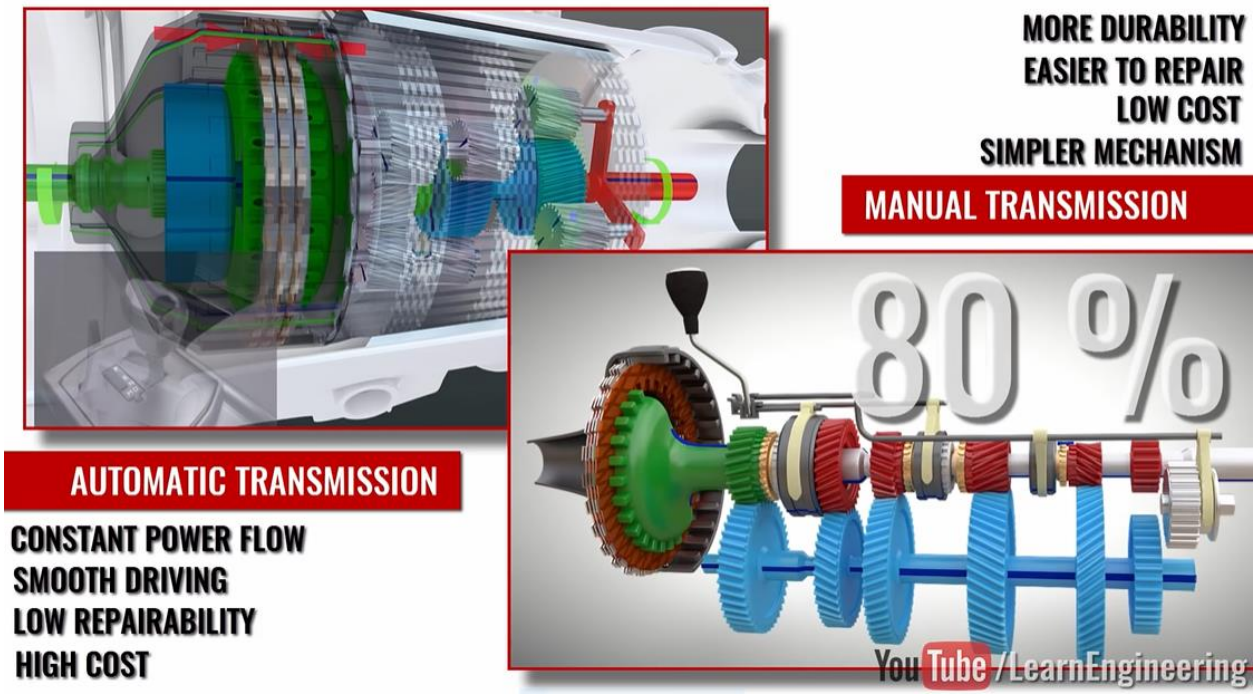
An ECU is a computer designed to control ignition and injection in an engine. It plays a central role in an EFI system, much like a carburetor and a distributor did in an old-school, mechanical system. ... With these a tuner will be able to map ignition timing and the amount of fuel needed at each interval.

8. Mention two ways that we could replace manual shifting (shifting gears by hand) and describe each way and how it works?

first way.







first speed → Gear one: C1, C5
first speed → Gear two: C1, C4
first speed → Gear three: C1, C3
first speed → Gear four: C1, C2
first speed → Gear five: C2, C3
first speed → Gear six: C2, C4
Reverse: C3, C5

9. *What is the main car engine sensors and what is the functionality of each one?*

1. Air–fuel Ratio Meter : Monitors the correct air-fuel ratio for the engine
2. Engine Speed Sensor : Monitors engine speed
3. Throttle Position Sensor :Monitors the position of the throttle in an engine
4. Crank Position Sensor : Monitors piston's TDC position in the engine
5. Cam Position Sensor : Monitors position of valves in the engine
6. Knock Sensor : Detects engine knocking because of timing advance
7. Engine Coolant Temperature Sensor : Measures the engine temperature
8. Manifold Absolute Pressure or MAP Sensor : Used to regulate fuel metering
9. Mass Air Flow or MAF Sensor : Notifies the mass of air entering the engine to ECU
10. Oxygen/O2/Lambda Sensor : Monitors the amount of oxygen in the exhaust
11. Fuel Pressure Sensor : Measures pressure in the fuel system
12. Vehicle Speed Sensor (VSS) : Measures the speed of a vehicle