Introduction:

A DC(Direct Current) power supply is a fundamental device in electronics that provides a constant or variable output of direct current to power electronic circuits and devices. In many applications, especially in electronics design, testing, and development, a variable DC power supply is often needed. This allows for adjusting the voltage and current levels to suit different components or circuits. This project aims to design and simulate a variable DC power supply using Proteus Software. The objective is to create a power supply that can output different voltage levels, allowing for flexibility in powering various electronic projects. Through this project, we will explore the design principles of DC power supplies, understand their components, and create a functional model that can be utilized for practical applications in electronics.

Objective:

- Convert alternating current (AC) from the mains into stable direct current (DC).
- Provide a reliable and consistent voltage output suitable for powering electronic devices and circuits.
- Protect sensitive components from power fluctuations and surges.
- Meet specific power requirements for various applications.
- Optimize performance and energy efficiency in the system.
- Ensure compatibility with different electronic components and systems.

Features:

- Regulated positive voltage
- Overvoltage protection
- Unervoltage protection
- Short circuit protection

Module Classification:

1. Rectification and filtering:

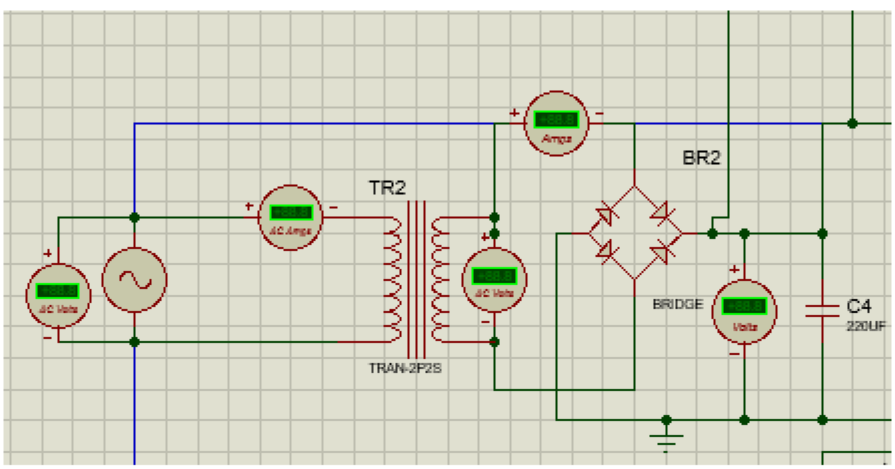
This circuit takes an AC input voltage, steps it down with the transformer, rectifies it with the bridge rectifier, and filters it with the capacitor. The resulting DC voltage can be used to power various electronic devices.

AC Source: A voltage source labeled "AC Voltage" provides the input alternating current (AC) power.

Transformer (TR2): A transformer labeled "TRAN-2P25" likely steps down the input voltage.

Bridge Rectifier (BR2): A bridge rectifier composed of four diodes converts the AC voltage into a pulsating DC voltage.

Capacitor (C4): A 220 uF capacitor filters the rectified DC voltage to smooth out the ripple.



2. Overvoltage and undervoltage protection:

This circuit functions as an overvoltage and undervoltage protection system. It monitors the input voltage and compares it to predefined thresholds. If the voltage exceeds the upper limit or falls below the lower limit, the circuit may activate a protection mechanism, such as disconnecting the load or triggering the LED.

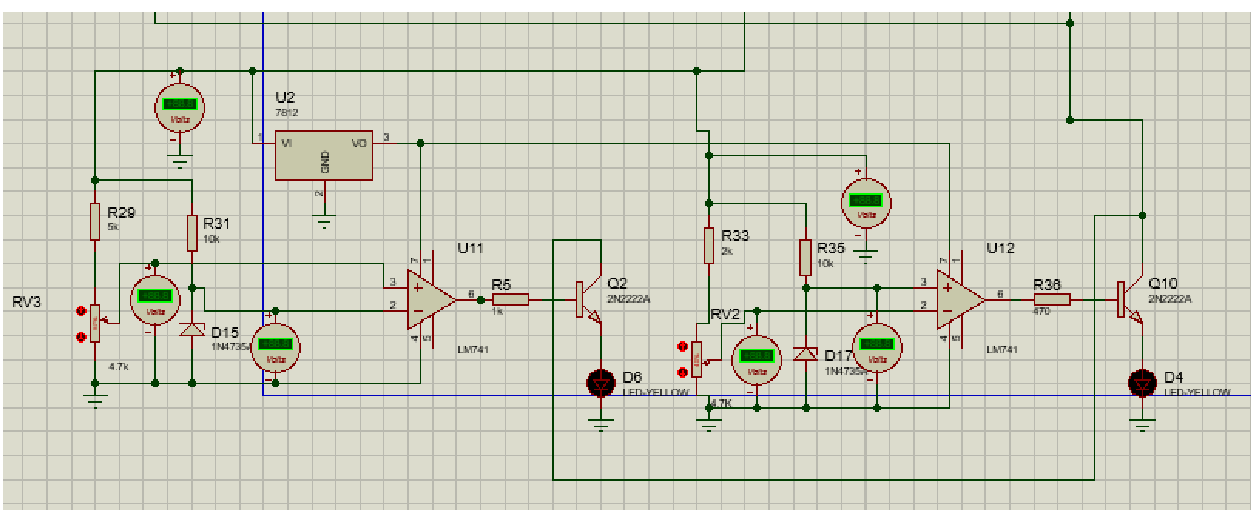
Voltage Regulators (U2, U11, U12): These components, labeled "7812" and "LM741", are likely responsible for regulating the voltage levels within the circuit.

Op-Amps (U11, U12): The operational amplifiers are likely used to compare the input voltage to reference voltages and generate control signals for the protection circuitry.

Transistors (Q2, Q10): These transistors, probably NPN types, may be used as switches to control the flow of current in the circuit, possibly to disconnect or bypass the load in case of overvoltage or undervoltage conditions.

Diodes (D6, D17, D4): The diodes labeled "1N4735" are likely Zener diodes, which can be used to provide reference voltages for the op-amps.

LEDs (LEDYELLOW): The yellow LEDs might indicate the status of the protection circuit, such as whether it is active or inactive



3.Regulator:

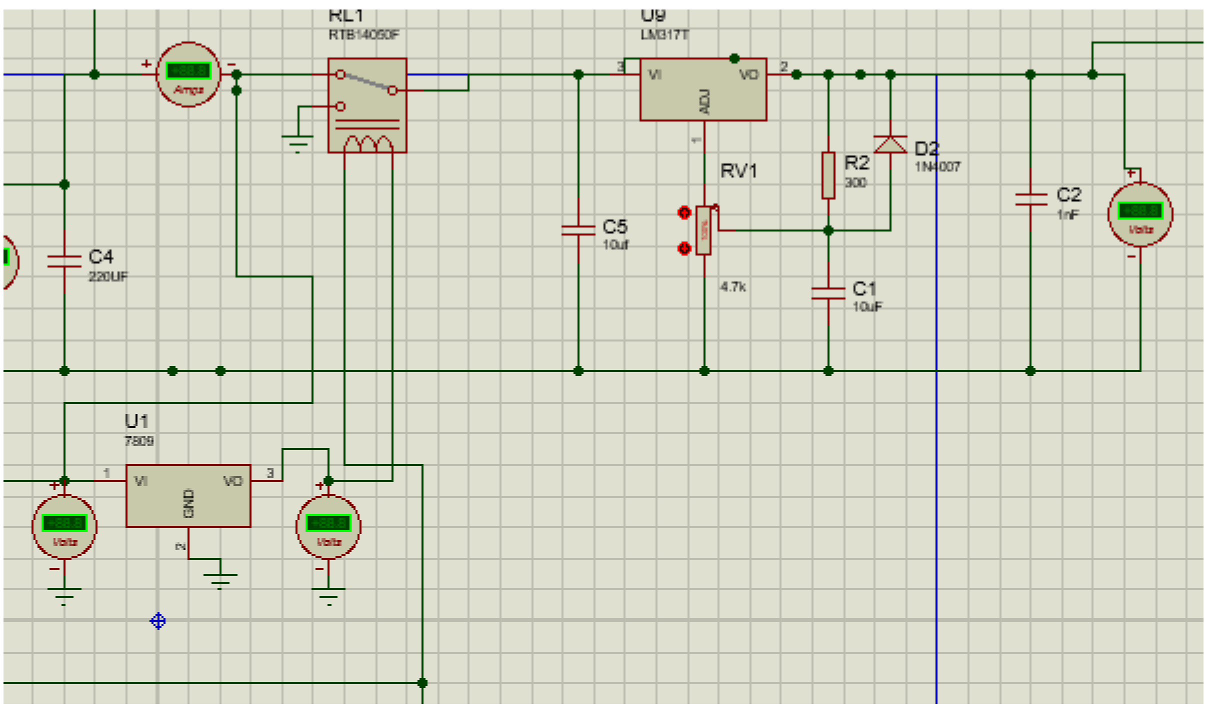
Voltage Regulator IC (7805): This provides a fixed 5V output by regulating the input voltage.

Capacitors (C4, C5, C1, C2): Various capacitors are used for filtering and stabilizing the voltage to ensure smooth DC output.

Relay (RL1): The relay helps control the flow of current, potentially switching between different parts of the circuit.

Adjustable Regulator (LM317): This component provides an adjustable output voltage. It's set up with a potentiometer (RV1) and resistors (like R2) to control the output level.

Diode (1N4007): Provides reverse polarity protection to prevent damage from incorrect connections.



4.Short circuit detection and protection:

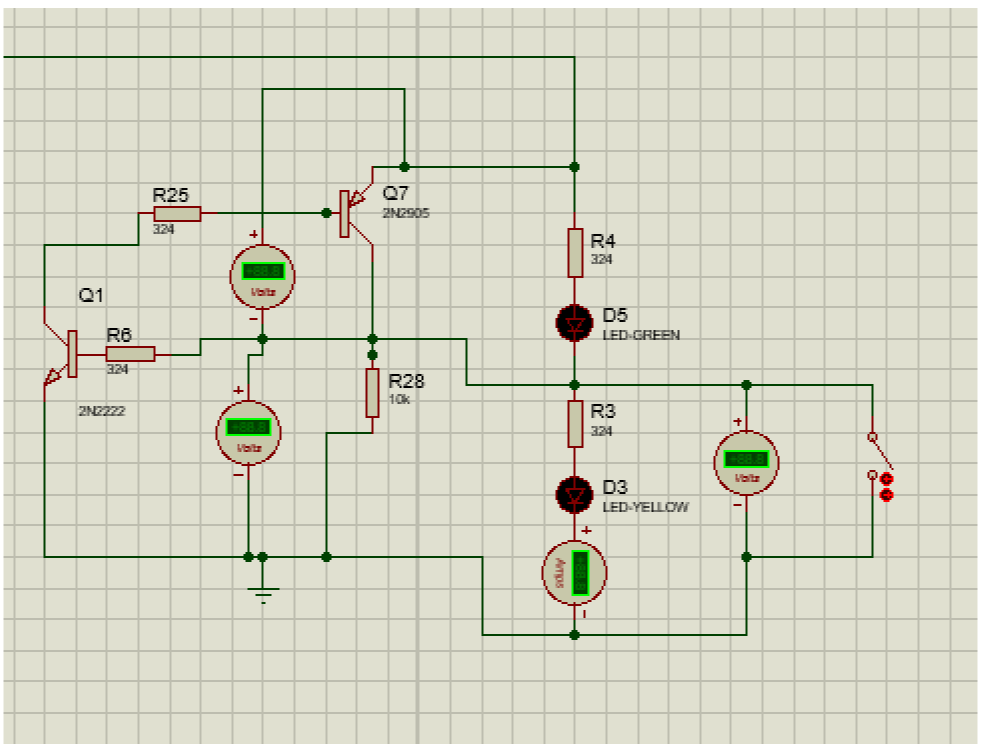
This circuit functions as a shortcircuit protection and detection system. It continuously monitors the circuit for any abnormal conditions, such as a short circuit. If a short circuit is detected, the circuit may activate a protection mechanism, such as disconnecting the load or triggering an alarm. The LEDs may indicate the status of the protection circuit, with the yellow LED possibly indicating a pre-fault condition and the green LED indicating a post-fault condition.

Transistors (Q1, Q7): These transistors, possibly NPN types, likely form part of the protection and detection circuitry.

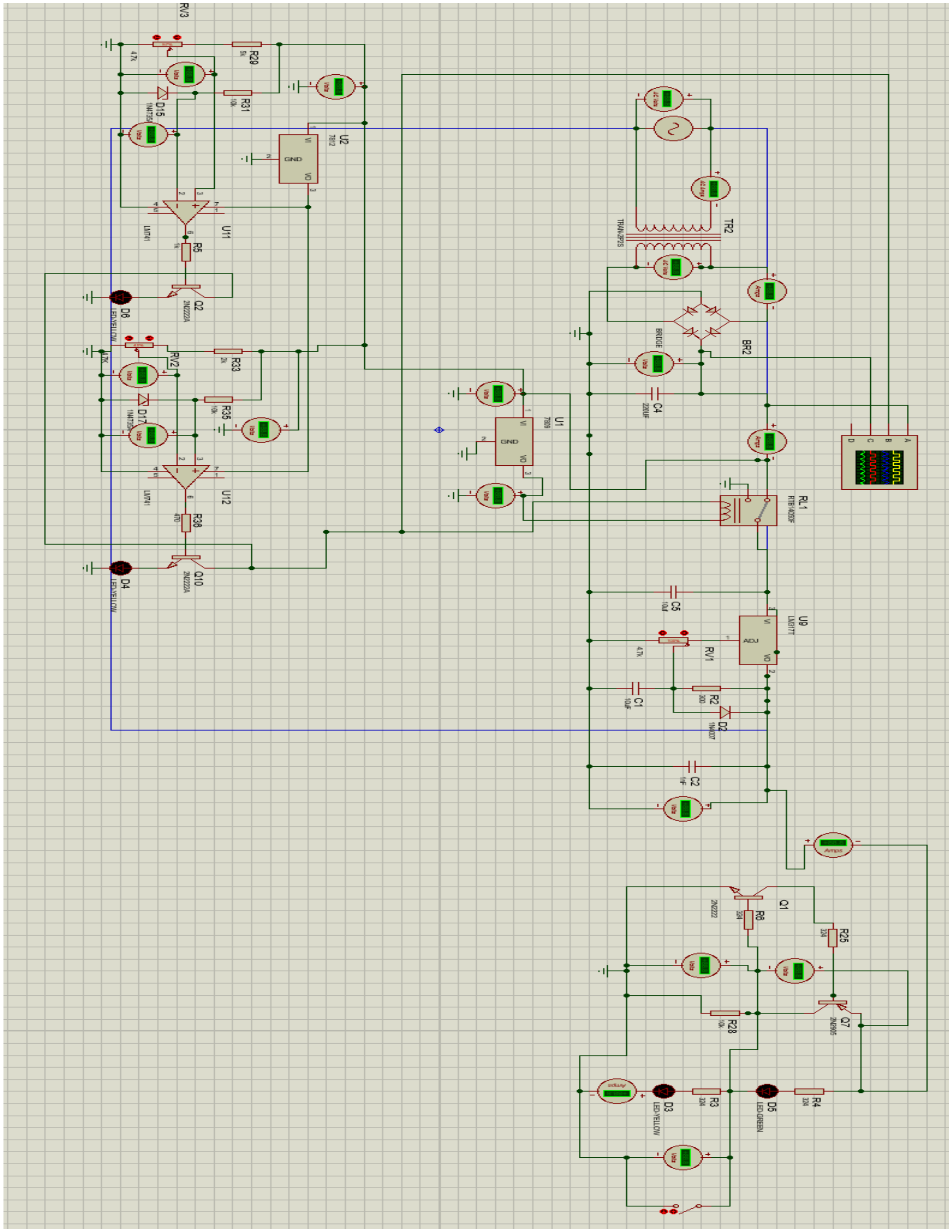
Resistors (R4, R8, R25, R28): These resistors likely set the operating points and thresholds for the circuit.

LEDs (D3, D5): The LEDs, labeled "LED-YELLOW" and "LED-GREEN", likely indicate the status of the protection circuit.

Switch (SW1): This switch may be used to simulate a short circuit condition for testing purposes.



Circuit Diagram:



Results:

Serial No.	Parameters	Proteus	Bread Board	PCB
01.	Regulated output voltage	1.4 - 23.8	1.43 - 20.35	1.4 - 19.3
02.	Input voltage	24.6V	18V	18V
03.	Input current	200mA	135mA	N/A
04.	Output current	70mA	52mA	N/A
05.	Minimum load	50 ohm	50 ohm	N/A
06.	Maximum current	500mA	480mA	N/A
07.	Input power	4.92W	2.43W	N/A
08.	Output power	1.66W	1.06W	N/A
09.	Efficiency	33.74%	43.6%	N/A
10.	Over voltage	260V	265V	245V
11.	Under Voltage	180V	200V	200V

Apparatus and Cost:

- **Estimated cost:**

Serial No.	Apparatus Name	Quantity	Cost
01.	AC Source	01	N/A
02.	Transformer	01	650 tk
03.	Diode	01	4 tk

04.	Capacitor	04	13 tk
05.	Resistor	10	20 tk
06.	Potentiometer	03	60 tk
07.	Relay	01	50 tk
08.	IC LM741	02	46 tk
09.	IC 7809	01	15 tk
10.	IC 7812	01	15 tk
11.	IC 317T	01	35 tk
12.	N-P-N Transistor	03	12 tk
13.	P-N-P Transistor	01	50 tk
14.	Zener Diode	02	85 tk
15.	LED	04	10 tk
16.	Multimeter	01	N/A
17.	Switch	01	6 tk
18.	Bridge Rectifier IC	01	50 tk
			Total : 1121 tk

- **Final budget:**

Serial No.	Apparatus Name	Quantity	Cost
01.	AC Source	01	N/A
02.	Transformer	01	195 tk
03.	Diode	05	20 tk
04.	Capacitor	04	13 tk
05.	Resistor	10	20 tk
06.	Potentiometer	03	60 tk
07.	Relay	01	50 tk
08.	IC LM741	02	46 tk
09.	IC 7809	01	15 tk
10.	IC 7812	02	30 tk
11.	IC 317T	01	35 tk
12.	N-P-N Transistor	03	12 tk
13.	P-N-P Transistor	01	50 tk

14.	Zener Diode	02	04 tk
15.	LED	04	4 tk
16.	Multimeter	01	N/A
17.	Junction	02	120 tk
18.	PCB Board	01	350 tk
			Total : 1024 tk

Note:

We used two instead of one 7812 ic. In place of a bridge rectifier IC, we used four diodes. PCB cost estimate has also been added, which was not previously included.

Contribution:

Roll	Contribution
2109038	assisted in the simulation process,hardware implementation,PCB layout design and final project report writing.
2109044	contributed to the simulation process,simulation hardware implementation,PCB printing and final project report writing.

Each member’s efforts were essential in completing the project successfully.

Complexity Faced:

In the designing and implementation we faced different types of complexity such as:

1.Component Selection:

Finding components that can handle the required voltage and current ratings while meeting the specifications for protection features can be challenging.

2.Voltage Regulation:

Achieving stable voltage regulation, especially under varying load conditions, requires careful selection and tuning of feedback loops in the regulator circuit.

3.Short Circuit Protection:

Implementing an effective short circuit protection that doesn't trip unnecessarily, while still protecting the supply, requires designing a fast response circuit without affecting overall performance.

4.Over & Under Voltage Protection:

Setting accurate thresholds for over and under voltage protection without creating instability or nuisance tripping can be tricky, especially when dealing with transient voltage spikes.

5. PCB Layout Challenges:

Proper layout is crucial to minimize noise, ensure stable voltage, and prevent interference between the protection circuits and the main supply path.

9.Testing and Calibration:

Extensive testing is needed to ensure that the protection circuits activate correctly under fault conditions and do not interfere with normal operation.

10.Cost vs Performance Trade-offs:

Balancing the cost of additional protection components with the overall performance and reliability of the power supply can be a key challenge.

These complexities often require iterative design, testing, and optimization to achieve a reliable and robust power supply.

Question:

Why is it a complex engineering problem?

Answer: Designing a power supply that satisfies several functional requirements such as voltage regulation, short circuit protection, and over/under voltage protection, while maintaining stability, dependability, and safety makes this project a complicated engineering task. It takes precise control and well-tuned feedback mechanisms to achieve steady and effective voltage regulation under a range of load circumstances. Furthermore, careful circuit design and component selection are required to integrate protection features without sacrificing performance or producing false triggers. Strong heat control, efficient noise reduction, and the difficulty of testing to guarantee that all systems function safely in the event of a breakdown all add to the difficulty. The interaction of these variables necessitates a comprehensive, iterative approach to optimization and design.

Conclusion:

To sum up, the design and implementation of a DC voltage supply with integrated features such short circuit safety, over/under voltage protection, and voltage management was a complex engineering challenge. With meticulous component selection, circuit design, and comprehensive testing, we were able to produce a strong and dependable power supply that can manage a range of fault scenarios and load levels. In order to guarantee that the system functions effectively and safely in all circumstances, the project illustrated the significance of striking a balance between performance, safety, and cost-effectiveness. The intricacies of power supply design and protection systems have been better understood as a result of this experience.