KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

KUET

COURSE NO.: ECE-2200

COURSE NAME: ELECTRONICS CIRCUIT DESIGN LAB.

PROJECT NAME

"REGULATED DC DUAL POWER SUPPLY"

PROJECT SUPERVISOR:	SUBMITTED BY:
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OBJECTIVES:

After completing this sessional we are able

- To design dual power supply.
- To regulate it from +20 to -20.
- To provide over voltage protection.
- To provide under voltage protection.
- To provide short circuit protection.
- To ensure low cost.
- To make the circuit reliable.
- To protect transformer.

INTRODUCTION:

Dual power supply units are common equipment in electrical engineering and electronics. They supply positive polarity (+Vcc) as well as negative polarity (- Vcc, not connected to ground!) and ground potential. A regulated power supply is an embedded circuit; it converts unregulated AC (Alternating Current) into a constant DC. Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits.

In some electronics equipment we need dual power supply like op-amp. For operating an op-amp we need positive voltage, negative voltage, and a ground supply.

There are some electric motors that can operate on two or three different voltages/lines, depending on how the motor is built and connected, in which case the voltages are either multiples of two or three of another. Another term worthy of mentioning is the Dual Trace Oscilloscope, which is simply the oscilloscope that can function and simultaneously display two signals.

THEORY:

A power supply is a major component that is used to supply power to electrical hardware. Also, it adjusts the power to an ideal amount to get electronics to run as smooth as possible. By contrast, it has three outputs: the positive, the negative and the zero. A dc power supply which instead of supplying with respect to ground would supply to different voltages one positive and the other negative at its two output pins and when required zero at the third pin.

If we want to supply +15V and -15V to a operational amplifier we would need a dc power supply which would provide these two voltages outputs at its two terminal.

The basic building blocks of a regulated DC power supply are as follows:

- ✓ A step-down transformer
- ✓ A rectifier
- ✓ A DC filters
- ✓ A regulator

OPERATION OF REGULATED POWER SUPPLY

Step Down Transformer

A step-down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

Transformer Protection, Rectification & Filtration:

To protect the transformer from over current of supply ac voltage we use a FUSE at the input terminal of the transformer. The rating of the FUSE is 1 Amp. So, if the current flow is over 1 amp, then the Fuse will be cut, and the transformer will be protected from being damaged.

Our main objective is to make a dc power supply. For that reason, we use bridge rectifier circuit. It contains four diodes connected to form bridge. We use 1N4007 series diodes. For the positive half cycle of a.c. Signal diodes d1 and d2 are forward biased and diodes d3, d4 are reversed biased. During the negative half cycles of a.c. signal diodes d1, d2 are reverse biased and diodes d3, d4 are forward biased. As a result, we get d.c. output all the time which is pulsating d.c. Then we have used a capacitor C1 for filtering. After this we have got pure d.c. power supply.

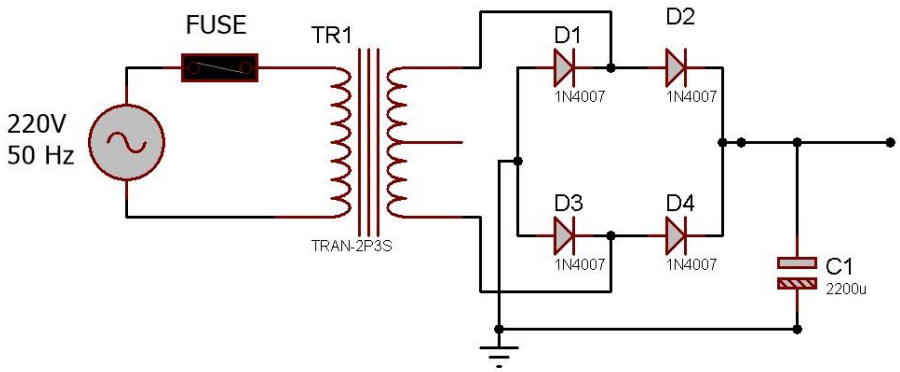

Fig 1: Bridge rectifier with Filter

Voltage Adjustable and Regulation:

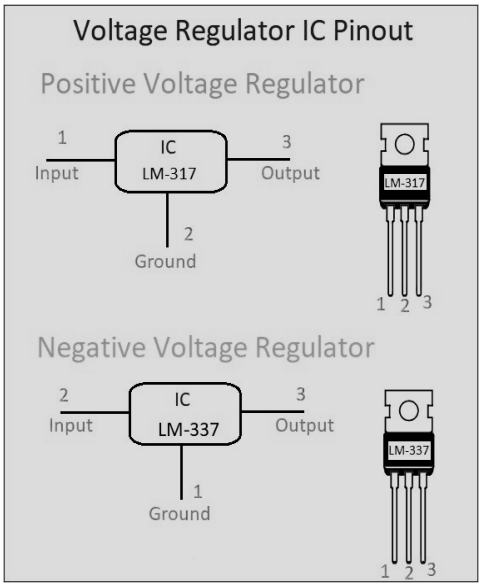

Fig 2: Voltage regulator IC pinout

Here we use a regulator and adjustable IC (LM317). We give 35v input to the IC. A 10k variable resistor use for varying the output. One diode (1N4002) is used for protecting the IC. Capacitor are used for making the input and output perfect DC. When the variable resistor varies from 0 to 10k then the output also varies from 1.2V to 35V.

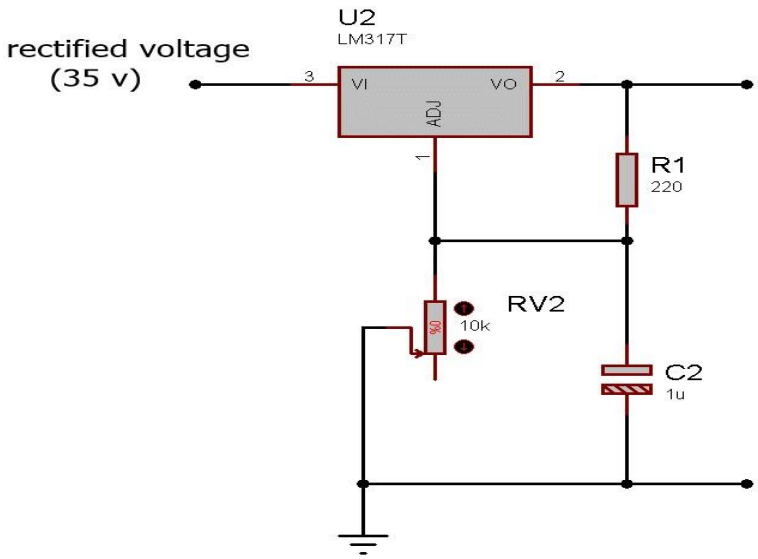

Fig 3: Voltage adjustable and regulation

Short Circuit Protection:

Just after the output of the regulator, a combination of two transistors and some resistors are seen. This is the basic short circuit protection unit. When the load is short circuited there will be no potential difference between the emitter and base of transistor Q2. So, the total current will flow through the transistor Q1 and to the ground. When the short circuit is separated, the current will again start flowing through the normal path. This way the load will be protected if short circuit occurs.

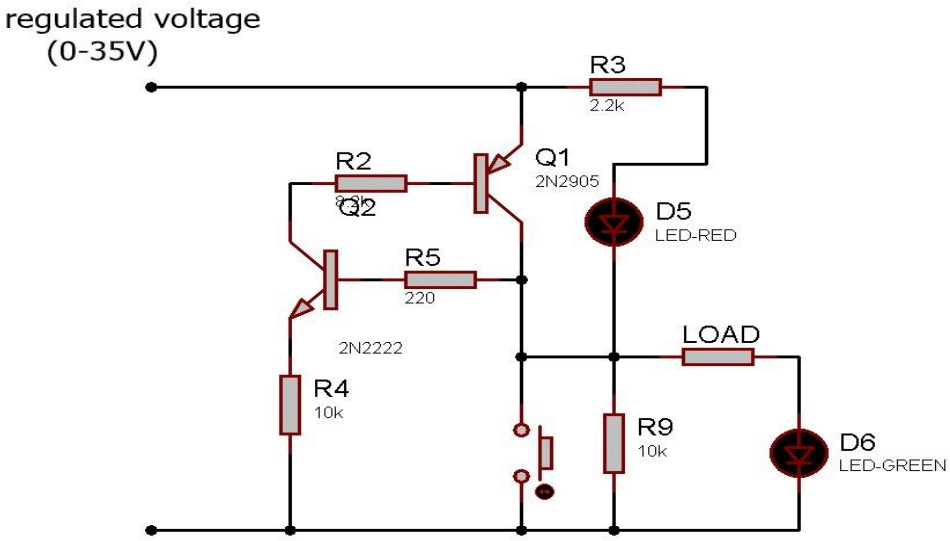

Fig 4: Short circuit protection

Over Voltage Protection:

The following portion performs over voltage protection. Rectified output is applied across voltage divider portion. Using Zener diode, a reference voltage is set which is applied to the inverting terminal of an Op-Amp. Again, using a voltage divider combination, a portion of rectified voltage is applied in the noninverting terminal. When rectified output changes, input voltage of noninverting terminal also changes and when it goes above reference voltage then comparator gives output voltage and Q4 becomes on and hence relay isolate the DC power supply.

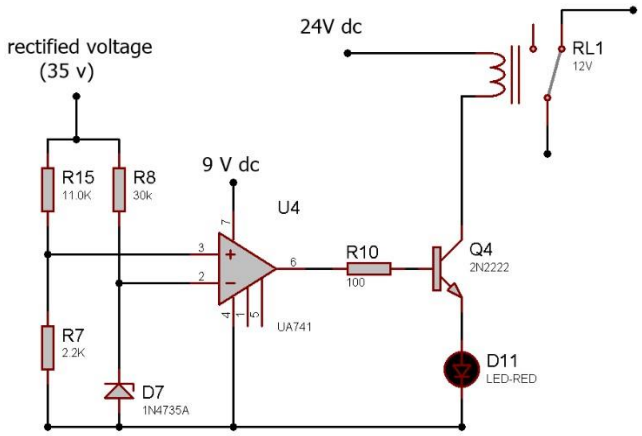

Fig 5: Over voltage protection

In this circuit, the reference voltage is 6V. If rectified output is above 40V, then non-inverting terminal voltage will be above (40*2.2/14.2)V or 6.1V and circuit will sense it as over voltage and power supply will be isolated. Here, LM7809 of Fig-1.1 has been replaced by 9V DC and LM7824 has been replaced by 24DC for simplification.

Under Voltage Protection:

This circuit provides under voltage protection. Rectified output is applied across voltage divider portion. Using Zener diode, a reference voltage is set which is applied to the non-inverting terminal of an Op-Amp. Again, using a voltage divider combination, a portion of rectified voltage is applied in the inverting terminal. When rectified output changes, input voltage of inverting terminal also changes and when it goes reference voltage then comparator gives output voltage and Q3 becomes on and hence relay isolate the DC power supply.

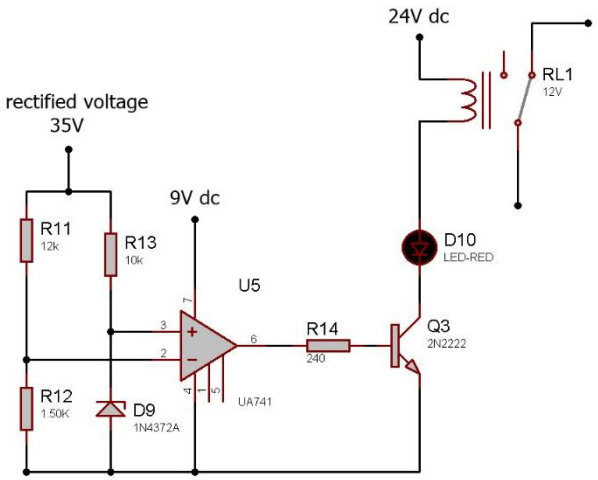

Fig 6: Under voltage protection

In this circuit, the reference voltage is 3V. If rectified output is under 27V, then inverting terminal voltage will be under (27*1.5/13.5)V or 3V and circuit will sense it as under voltage and power supply will be isolated. Here, LM7809 of Fig 1 has been replaced by 9V DC and LM7824 has been replaced by 24V DC for simplification.

APPARATUS LIST:

Serial No.	Name Of The Apparatus	Ratings	Quantity
01	Transformer	220V to 24V,1A	1
02	Diode	1N4007	8
03	ZENER Diode	6V,3V	2
04	Capacitor	2200uF,1uF,10uF	3
05	Resistor	10k,22.2k,1.5k,47k,3.3k,8.2k, 470ohm,100ohm	26
06	Op-Amp	LM-741	2
07	Adjustable regulator IC	LM-317 LM-337	2
08	Regulator IC	LM7805, LM7824, LM7809	3
09	Variable resistor	5k&10k-ohm	4
10	Transistor	2N2905,2N2222	2
11	Relay	12volts	4
12	LEDs	5V	4
13	Fuse	300v, 1A	1

CIRCUIT DIAGRAM:

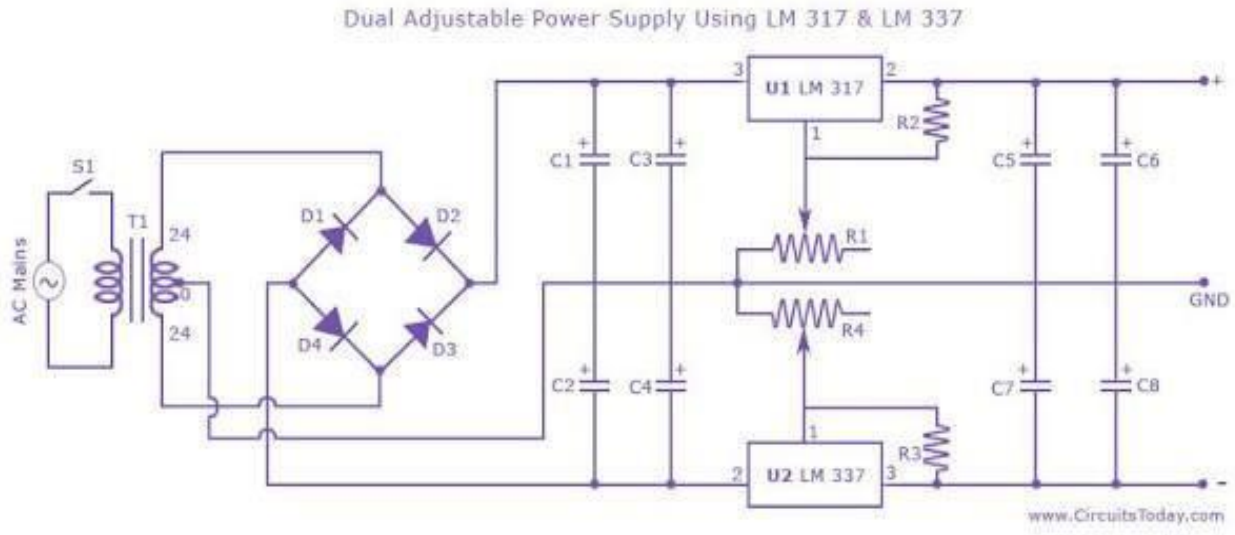

Fig 7: Circuit diagram of regulated dual power supply.

MEASUREMENT:

Table 1: Measurement of Output Voltage, Current & Power for Different Loads with 14 volts supplying

Observation No.	Load resistor (ohm)	Voltage across load (volts)	Current through load (mA)	Power of the load (mW)
01	1.5k	11.84	8.2	97.08
02	4k	12.65	3.26	41.23
03	7k	12.36	1.7	21.01
04	8k	11.73	1.5	17.6
05	10k	12.43	1.3	16.16
06	22k	12.36	1.1	13.59

GRAPHICAL ANALYSIS:

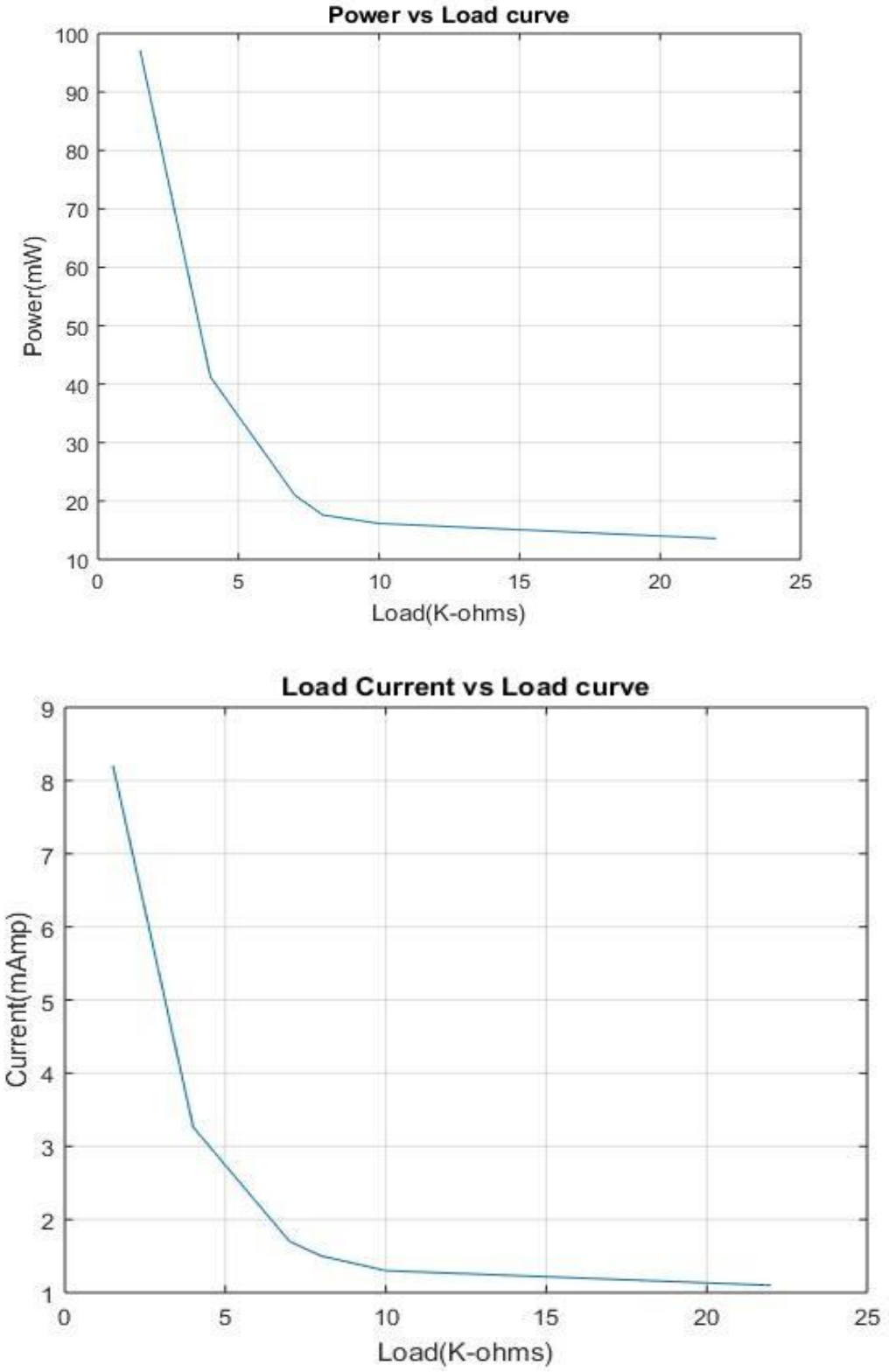

Fig 8: (a) Power vs Load (b) Load Current vs Load

COST ANALYSIS:

Apparatus name	Ratings	Rate	Quantity	Total Price
Transformer	12v, 1A	85	1	85
Diode	1N4007	1	6	6
Fuse	1A	5	1	5
Capacitor	2200µF, 1µF, 0.1uF	20+2+2	1+1+1	24
IC	LM7824, LM7808, LM317	8+8+20	1+1+1	36
Op-Amp	LM7741	15	2	30
Zener Diode	6v	2	2	4
Battery	9v	30	3	90
Transistor	2N2222,2N2905	4+65	3+1	77
Relay	6v	20	2	40
Variable resistor	10k,1k	20	2	40
Resistor	100ohm,470ohm, 1.5k,2.2k 3.3k,8.2k,10k,22k ,47k	0.50	16	8
				Total = 445 Tk

PROBLEM WE FACED:

In this experiment we have faced some problem. Voltage protection is an important thing. To maintain this, we have calculated the voltage references. But we according to our calculations we did not gate the equipment first & for loose relay connections our value was fluctuating and for some carelessness some equipment was burnt.

To overcome this problem:

- ✓ Relay should be welding.
- ✓ There should not be any loose connections in the breadboard.
- ✓ To protect the circuit for over and under voltage protection we should calculate the value with the available components

ADVANTAGES OF DUAL POWER SUPPLY:

Constant Power:

A single–phase circuit, instantaneous power varies sinusoidally. However, a dual power supply ensures constant power supply to a device when one power source fails, which could be as a result of a lot of factors.

Increases Power Output:

More power is guaranteed whenever a dual DC power supply is engaged, compared to a single power source. Just like supply frequency, it multiplies the power supply by 2.

Constant Power:

A rig that uses dual DC power supply is guaranteed with constant and uninterruptible power supply. Again, a desktop computer can receive dual power supply, one for the fan and the second one for the motherboard. This set up ensures that power supply is not compromised whenever a device is switched on due to fluctuation of voltage. An electricity power supply can fluctuate whenever we add a load to it. Fluctuation of electric current is one of the major causes of damage to computer systems.

Convenient Temperature:

Extra power supply does not change the case temperature as may logically be expected.

DISCUSSION:

In this laboratory we have designed a Dual Power Supply and have implemented it which it fulfills our requirement like it gives us regulated positive output, regulated negative output, over voltage protection, under voltage protection, short circuit protection and it also contains fine tuning. At the short circuit protection, the output current is limited by resistor R2. So, if one unwillingly grounded the supply, it would not harm the internal circuit. Again, fuse gives the protection of the transformer from being damaged. The circuit isolates the output from over & under voltage. Hence, we get a complete design for our desired project. But it has some disadvantages. The power loss of the circuit is quite high.

CONCLUSION:

This experiment has been given us enough knowledge how to implement a circuit and to introduce with various electronics equipment's like voltage regulator, relay, IC etc. It increases our skill about circuit.