RISE Lab at RGCET: Empowering Innovation and Practical Skills

The RISE Lab at Rajiv Gandhi College of Engineering and Technology (RGCET) is a cutting-edge facility dedicated to fostering the creative and practical skills of engineering students. With a focus on applying science, technology, and engineering fundamentals, the lab offers students an invaluable hands-on experience that enhances their learning through doing. By engaging with real-world projects, students are encouraged to move beyond theoretical knowledge and towards practical applications that can lead to innovative solutions and even product development.

Vision and Objectives of RISE Lab

The primary mission of the RISE Lab is to empower students to be imaginative and creative engineers who are well-versed in practical skills. The lab acts as a common facility embedded within the institution, where engineering students can explore and experiment with ideas, bringing them to life through prototypes and products. The lab's purpose is to cultivate an environment where students and faculty alike can "Engage, Explore, Experience, Express, and Excel" in their innovative ideas, following a journey from conception to prototype to new product development.

Evolution of the RISE Lab

The RISE Lab, formerly known as the Innovations and Idea Lab (IIL), was renamed in November 2023 following the implementation of the National Education Policy (NEP-2020). This rebranding aligns with the lab's expanded role in equipping students with practical skills and innovative thinking, making them industry-ready in a rapidly changing technological landscape.

Key Training and Projects at RISE Lab

One of the primary focuses of the RISE Lab is providing fundamental training in areas critical to engineering and technology. For example, first-year students receive training in PCB (Printed Circuit Board) board-level soldering techniques. This hands-on training introduces students to the basics of electronics assembly and provides a foundation for more complex projects in the future.

In addition to PCB training, the lab's technical team has also conducted LED assembling workshops, where students gained practical experience in assembling LED bulbs. Over 290 LED bulbs, both 22W and 9W, were assembled by the students, showcasing the lab's focus on real-world applications and energy-efficient technologies.

The RISE Lab's influence extends beyond the classroom, as students have assembled and installed LED lighting boards at the entrance and along the compound walls of the college. This project not only provided students with a sense of accomplishment but also contributed to improving the campus environment.

Impact of RISE Lab

The impact of the RISE Lab on students and faculty at RGCET is multifaceted. By providing opportunities for hands-on learning, the lab fosters a spirit of innovation and creativity, making engineering graduates more capable and confident in their skills. The experience gained in the lab prepares students to face the challenges of the modern engineering industry, where the ability to turn ideas into tangible products is highly valued.

Furthermore, the RISE Lab encourages interdisciplinary collaboration, allowing students and faculty from various departments to work together on projects. This collaborative environment enhances the overall learning experience and prepares students for the teamwork required in professional engineering careers.

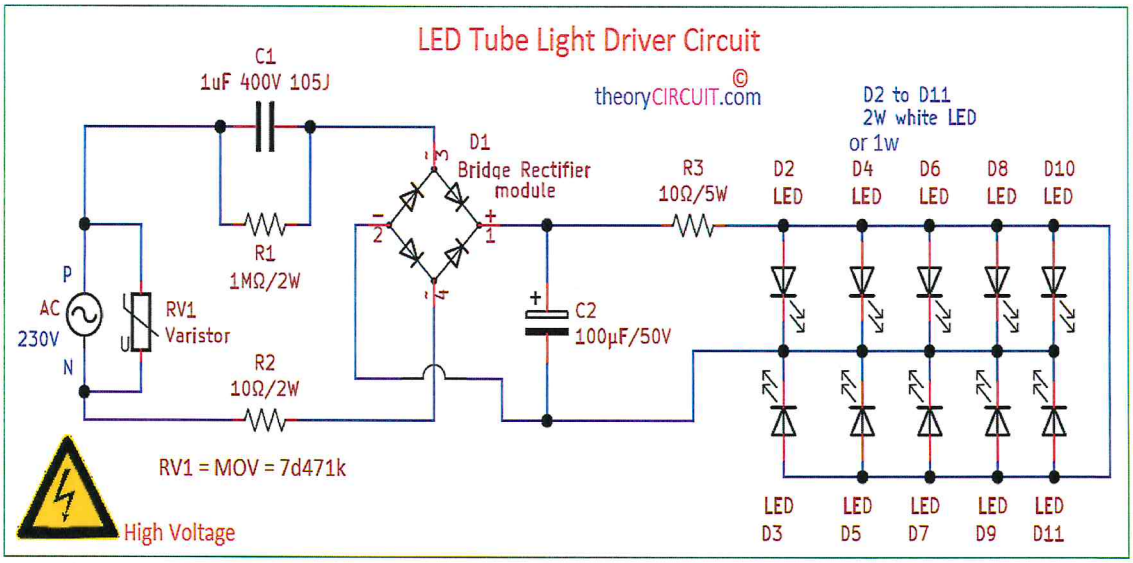
Future Directions

As the RISE Lab continues to evolve, it is poised to become a hub for innovation and entrepreneurship at RGCET. With the integration of advanced technologies and the promotion of a maker culture, the lab will play a crucial role in shaping the next generation of engineers. By

continuing to offer hands-on training and real-world project opportunities, the RISE Lab will ensure that RGCET graduates are not only knowledgeable but also skilled in applying their knowledge to solve real-world problems.

In summary, the RISE Lab at RGCET stands as a beacon of innovation and skill development, empowering students to transition from learners to creators. Through its focus on hands-on experience and product visualization, the lab is a cornerstone in the college's mission to produce imaginative, creative, and industry-ready engineering graduates.

Main Circuit Diagram



230v LED Driver Circuit

We have designed a simple 230V LED Driver circuit, which can drive LED directly from the mains supply.

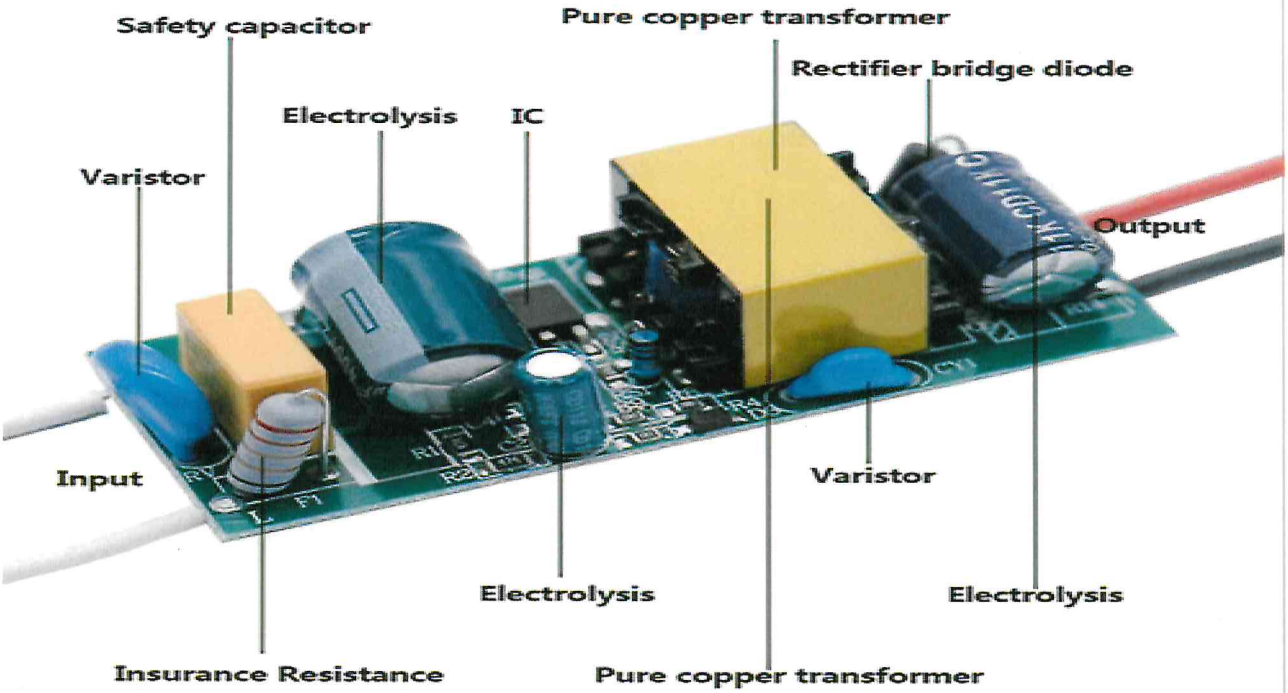
An LED is a special type of diode used as an Optoelectronic device. Like a PN junction diode, it conducts when forward biased. However, a special feature of this device is its ability to emit energy in the visible band of the electromagnetic spectrum i.e. visible light.

A major concern to drive an LED is to provide an almost constant current input. Often, an LED is driven using batteries or control devices like microcontrollers. However, these have their own disadvantages, for example – low battery life etc.

A feasible approach would be driving the LED using AC to DC power supply. Though AC to DC power supply using transformer is quite popular and widely used, for applications like driving loads like LED, it proves to be quite costly and moreover it is not possible to produce a low current signal using transformer.

Keeping in mind all the factors, here we designed a simple circuit driving an LED from 230V AC. This is accomplished using a capacitor based power supply. This is a low cost and efficient circuit and can be used at homes.

Driver Circuit



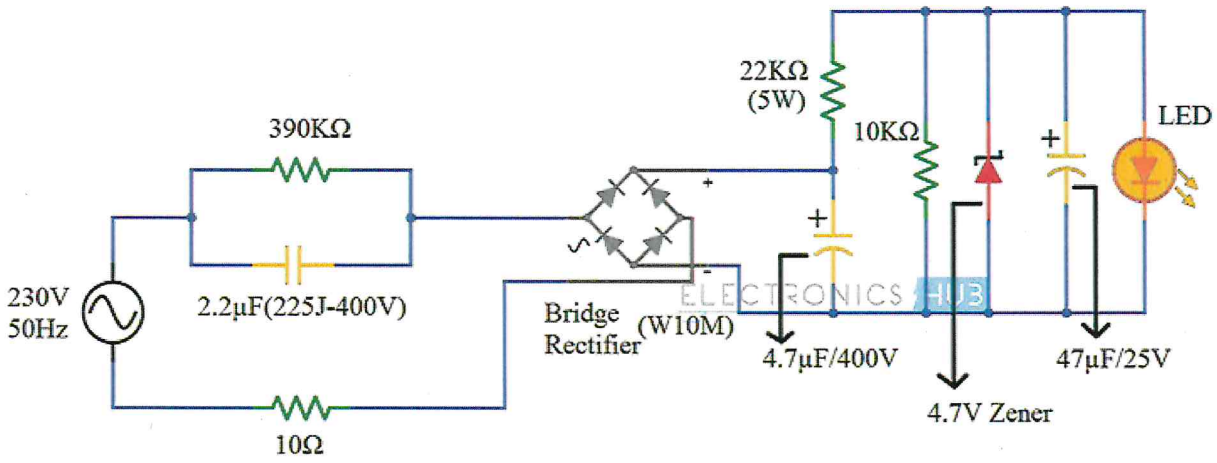
230v LED Driver Circuit Principle

The basic principle behind the 230V LED Driver circuit is transformer less power supply. The main component is the X-rated AC capacitor, which can reduce the supply current to a suitable amount. These capacitors are connected line to line and are designed for high voltage AC circuits.

The X – Rated Capacitor reduces only the current and the AC voltage can rectify and regulated in the later parts of the circuit. The high voltage and low current AC are rectified in to high voltage DC using a bridge rectifier. This high voltage DC is further rectified using a Zener diode to a low voltage DC.

Finally, the low voltage and low current DC is given to an LED.

230v LED Driver Circuit Diagram



Components Required

- 2.2µF Polyester Film Capacitor (225J – 400V)
- 390KΩ Resistor (1/4 Watt)
- 10Ω Resistor (1/4 Watt)
- Bridge Rectifier (W10M)
- 22KΩ Resistor (5 Watt)
- 4.7µF / 400V Polarized Capacitor
- 10KΩ Resistor (1/4 Watt)
- 4.7V Zener Diode (1N4732A) (1/4 Watt)
- 47µF / 25V Polarized Capacitor
- 5mm LED (Red – Diffused)

Design of a 230V LED Driver Circuit

First, a 2.2µF / 400V X – Rated Capacitor is connected in line with the mains supply. It is important to pick a capacitor with voltage rating greater than the supply voltage. In our case, the supply voltage is 230V AC. Hence, we used a 400V rated capacitor.

A 390KΩ resistor is connected in parallel with this capacitor to discharge it when the supply is turned off. A 10Ω resistor, which acts as a fuse, is connected between the supply and bridge rectifier.

The next part of the circuit is a full wave Bridge Rectifier. We have used a single chip rectifier W10M. It is capable of handling currents up to 1.5 Amperes. The output of the Bridge Rectifier is filtered using 4.7µF / 400V Capacitor.

For regulating the DC output of the Bridge Rectifier, we are using a Zener Diode. A 4.7V Zener Diode (1N4732A) is used for this purpose. Before the Zener Diode, we have connected a series resistor of 22KΩ (5W) for limiting the current.

The regulated DC is given to the LED after filtering it out using 47µF / 25V Capacitor.

Working of 230V LED Driver Circuit

A simple, transformer less 230V LED Driver Circuit is built in this project. The main components of this project are the X – Rated Capacitor, the Zener Diode and the resistor which limits the current in the Zener Diode. Let us see the working of this project.

First, the 2.2µF X – Rated Capacitor (225J – 400V) will limit the AC current from the mains supply. In order to calculate this current, you have to use the Capacitive Reactance of the X – Rated Capacitor.

The formula for calculating the Capacitive Reactance is given below.

$$Capacitive\ Reactance\ X_C = \frac{1}{2\pi FC}$$

So, for 2.2µF Capacitor, X_C can be calculated as follows.

$$X_C = \frac{1}{2\pi * 50 * 2.2 * 10^{-6}} = 1447.59$$

So, from Ohm's Law, the current that the capacitor allows is given by I = V/R.

Hence, the current through the capacitor is = 230/1447.59 = 0.158 Amperes = 158mA.

This is the total current that enters the bridge rectifier. Now, output of the Bridge Rectifier is filtered using a Capacitor. It is important to select an appropriated voltage rating for this capacitor.

The input to the Bridge Rectifier is 230V AC, which is the RMS Voltage. But the maximum voltage at the input of the Bridge Rectifier is given by

$$V_{MAX} = V_{RMS} \times \sqrt{2} = 230 \times 1.414 = 325.26\ V.$$

Hence, you need to use a 400V rated filter capacitor. The Rectified DC voltage is around 305V. This must be brought down to a usable range for lighting up the LED. Hence, the Zener Diode is used in the project.

A 4.7V Zener Diode is used for this purpose. There are three important factors associated with the Zener Diode that is acting as a regulator: A Series Resistor, Power Rating of that Resistor and the Power Rating of the Zener Diode.

First, the Series Resistor. This resistor will limit the current flowing through the Zener Diode. The following formula can be used in selecting the series resistor.

$$R_S = \frac{V_{IN} - V_Z}{I_L + I_Z}$$

Here, V_{IN} is the input voltage to the Zener Diode and is = 305V.

V_Z is the Zener Voltage (which is same as the load voltage V_L) = 4.7V.

I_L is the load current i.e. the current through the LED and is = 5mA.

I_Z is the current through the Zener Diode and is = 10mA.

Therefore, the value of the Series Resistor R_S can be calculated as follows.

$$R_S = \frac{305-4.7}{5*10^{-3}+10*10^{-3}} = 20020\Omega$$

Now, the Power Rating of this Resistor. The Power Rating of the series resistor is very important as it determines the amount of power the resistor can dissipate. To calculate the power rating of the Series Resistor R_S, you can use the following formula.

$$\text{Power Rating of } R_S = \frac{(V_{IN}-V_Z)^2}{R_S} = \frac{(305-4.7)^2}{20020} = 4.5W$$

Finally, the Power Rating of the Zener Diode. You can use the following formula to calculate the Power Rating of the Zener Diode.

$$\text{Power Rating of Zener Diode} = \frac{(V_{IN}-V_Z)*V_Z}{R_S} = \frac{(305-4.7)*4.7}{20020} = 0.07W$$

Based on the above calculations, we have chosen the series resistor of 22KΩ Resistance rated at 5W and a 4.7V Zener Diode rated at 1W (actually, a quarter Watt Zener would suffice).

The rectified and regulated voltage with limited current is given to the LED.

Construction & Working

This White LED circuit Construction without any transformer and it can be directly connected to the AC Mains supply from 110V to 230V, Frequency between 30Hz to 50Hz. First part of this circuit is Rectification and Second part is LED array. AC supply connected with Metal Oxide Varistor (MOV), this is a voltage suppression element, it will protect following circuit element from switching voltage and current surges.

Capacitor C1 and Resistor R1 allows minimum amount of AC supply to the Bridge Rectifier module, Here AC supply Rectified into DC supply then Capacitor C2 filters the AC ripples in DC supply. After that DC supply applied to the White LED array. When we switch ON the circuit then White LED array starts to glow.

Advantages

- With the help of this 230V LED Driver Circuit, we can drive LEDs directly from the main supply.
- This project is based on a Transformer Less Power Supply. Hence, the final build won't be a large one.

Applications of 230V LED Driver Circuit

1. This circuit can be used for home lightening systems.
2. It can be used as an indicator circuit.
3. One can fix this circuit with the door bell to give indication.

Limitations of 230V LED Driver Circuit

1. Since 230V AC supply is being directly used here, this circuit can be dangerous.
2. This circuit is best suited for domestic applications using single phase supply. This is because, in case of three phase supply, if any of the phases accidently touches the input terminal, it can prove to be quite dangerous.
3. The capacitor can produce spikes at mains fluctuations.

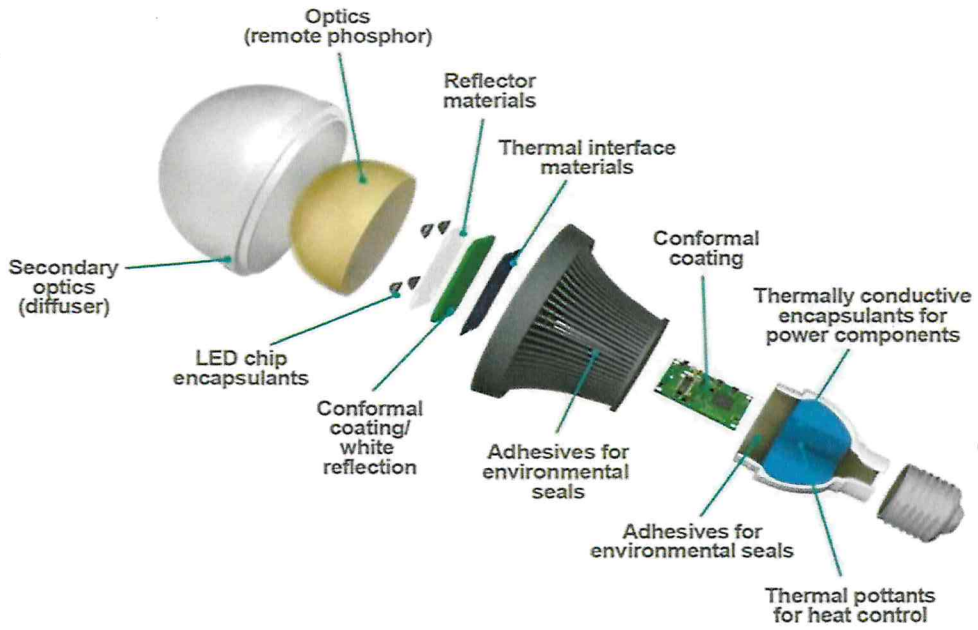
IDEA LAB

LED Tube light Assembly

Tools List

1. 12 watts Soldering Iron - 1 No
2. Soldering Iron Paste - 1 No
3. Soldering Lead - 1 No
4. De-soldering Pump - 1 No
5. IPU bottle (small) - 1 No
6. Knife - 1 No

Parts of an LED Bulb



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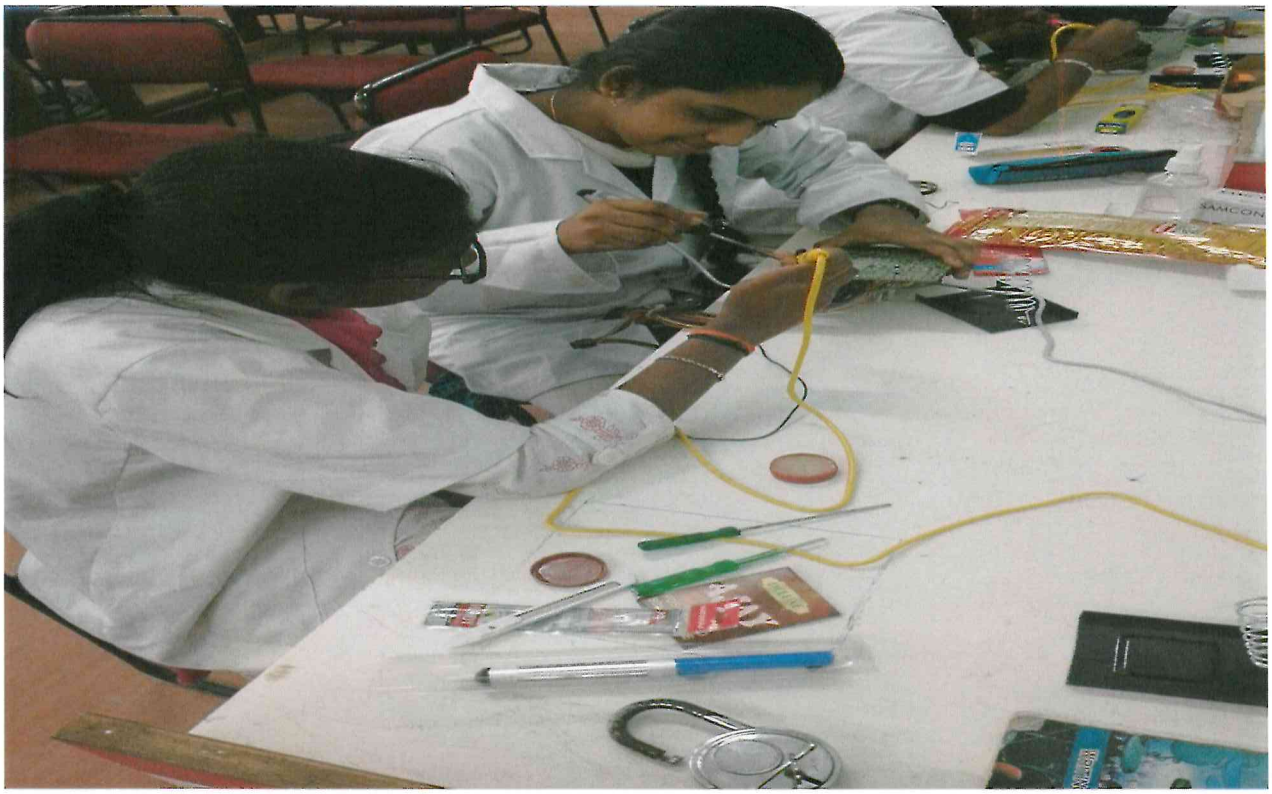

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