PROJECT ON :-

Tube light working and white color emission and compared it with white LED

Term Paper

Name- Himanshu Singh

Roll No- 31

SEC- K24FK

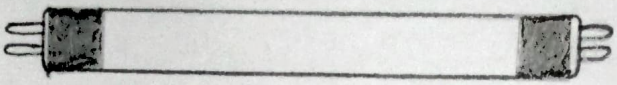
Reg No- 12411444

Sub-PHY110

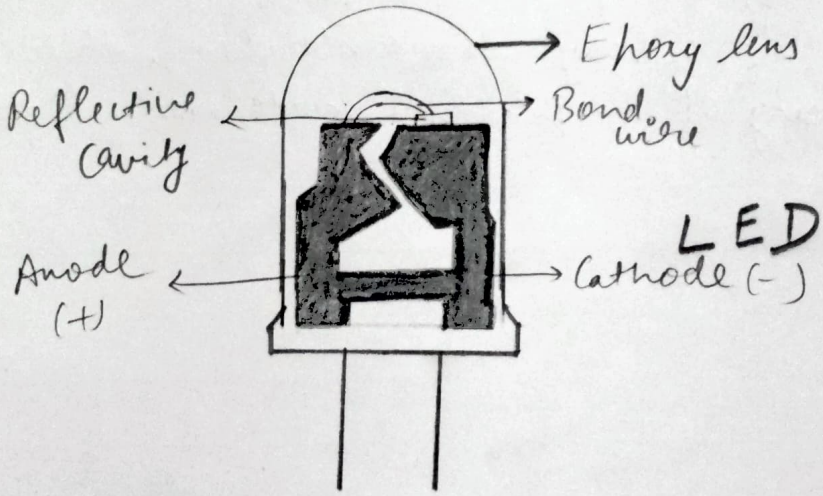
Topic _____ Date _____

ABSTRACT

This project explores the working principles of tube lights and white LEDS, with a focus on their mechanisms for emitting white light. Tube lights rely on phosphor-coated glass and mercury vapour to produce visible light, while LEDS generate light through semiconductor technology. The study compares these two lighting systems based on efficiency, color quality, ~~quantity~~ lifespan and environmental impact ultimately demonstrating the superiority of LEDs as a sustainable lighting option.



Tubelight



Topic_____ Date_____

INTRODUCTION

Artificial lighting has evolved significantly over the years, with tube lights and LED lights being prominent examples. A tube light, also known as a fluorescent, has been widely used for its brightness and efficiency over incandescent lights. Recently, LEDs (Light Emitting Diodes) have emerged as superior alternative, especially white LEDs, due to their energy efficiency and longer lifespan. This project examines how tube lights emit white light and compares it with the mechanism and advantages of white LEDs.

* LED → A light emitting diode is a semiconductor device the emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process.

* Tube light → A tube light also known as fluorescent lamp, is a cylindrical electrical device that converts electrical energy into visible lights.

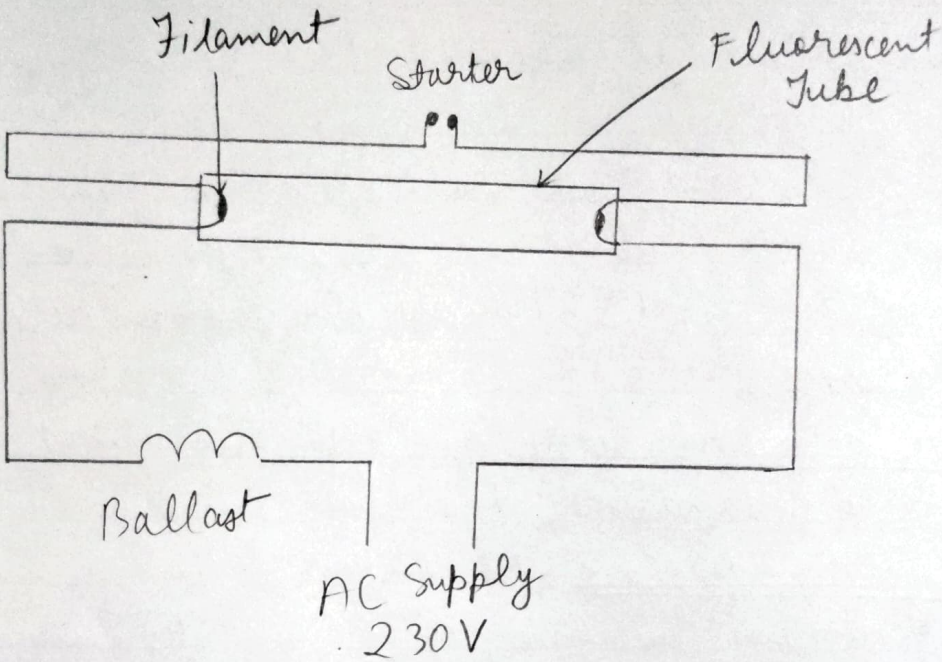
Topic _____ Date _____

PROPOSED METHODOLOGY

This project will follow these key steps:.

1) Study of light Emission Mechanism: Explore how both tube light and LEDs produce white light through their respective process.
2) Experimental Setup: Set up tube light systems with standardized power sources.
3) Data collection: Measure the power consumption brightness (in lux), color quality (using a spectrometer), and other relevant factors.
4) Analysis: Analyze and compare findings on the basis of efficiency color rendering, environmental impact and lifespan.

Working Principle



Tubelight

Topic _____ Date _____

CONSTRUCTION AND PERFORMANCE

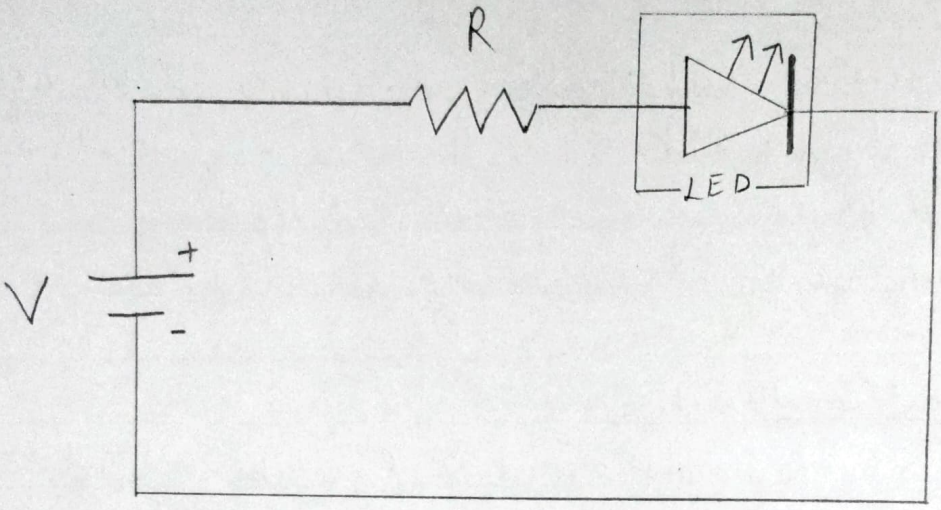
The construction and working principles of tube light and LEDs differ significantly. The following sections provide a break down of each technology's core components and operational behaviors:

1) Tube light Construction:

- Components: A phosphor-coated glass tube filled with low-pressure mercury vapor, electrodes at both ends, a ballast, and a starter.
- Working: When turned on, a high-voltage are excites mercury vapour atoms, releasing ultraviolet (UV) light. The phosphor ~~coming~~ coating converts UV light to visible light.
- Performance: Known for its bright even light, but requires a warm-up period and has relatively high power consumption.

2) White LED Construction:

- Components: Comprises an LED chip, phosphor coating, and a lens to focus the light.
- Working: The LED chip emits blue or near-UV light when an electric current flows through it. This light excites the phosphor coating, producing white light.



LED Circuit

Topic _____ Date _____

- Performance: LEDs are energy-efficient, instantly bright, and exhibit higher color stability with longer operational lifeSpan.

Types

1) ~~Types of light~~ Tube Light Types
   - Standard Fluorescent Tube: Uses a mercury-activated phosphor coating for white light.
   - Compact Fluorescent lamps (CFL): A smaller, coiled version of tube lights designed for compact fixtures.
2) White LED Types
   - Single Phosphor-Coated LED. Uses a blue LED chip with a phosphor coating to emit white light.
   - RGB LED: Combines red, green, and blue LEDs to produce white light by additive color mixing.

Topic _____ Date _____

DESIGN

The design of tube lights and LEDs reflect their differing technologies:

- Tube Light Design: A straight glass tube with internal phosphor coating and sealed electrodes at each end. This design requires an external and ballast for current regulations

- LED Design: Typically compact with LED chips embedded in a small encapsulation. While LEDs often have a phosphor layer for white light production and a heat sink for managing heat dissipation.

Topic _____ Date _____

COMPONENTS

1. Tube light components
   - Phosphor-Coated Glass Tube
   - Mercury Vapor
   - Electrodes.
   - Starter and Ballast

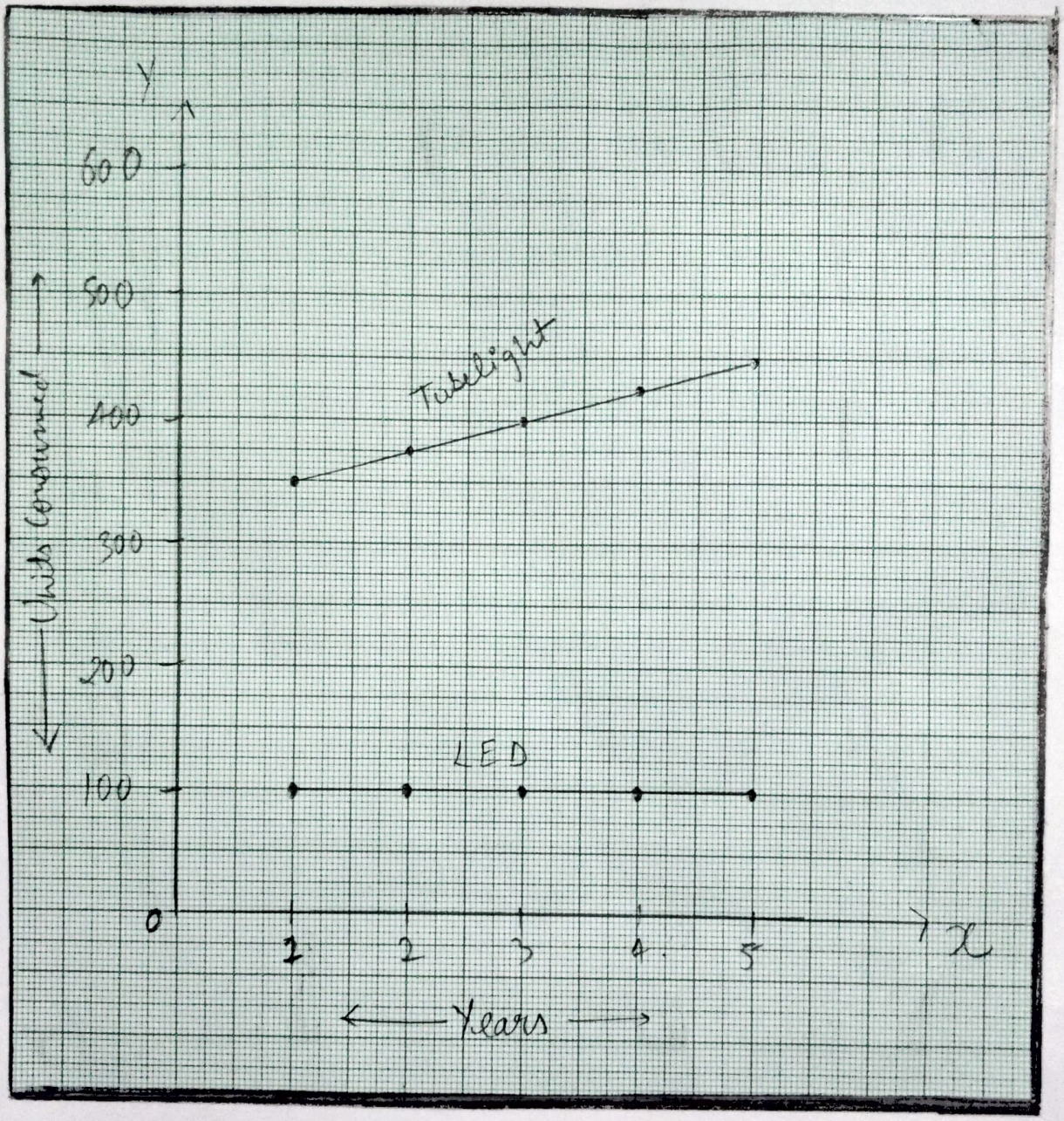
2. White LED components
   - LED chip
   - Phosphor Coating
   - Encapsulating lens

Topic _____ Date _____

FINAL ASSEMBLY

1. Tube light Assembly
   - The glass tube is filled with mercury and sealed with electrodes on both ends.
   - Phosphor is coated on the inner surface of the tube.
   - The starter and ballast are connected to regulate the electrical current.

2. LED Assembly
   - The LED chip and phosphor layer are ~~connected~~ combined and encapsulated in a lens, which focuses the emitted light.
   - The assembly is often mounted on a heat sink to prevent overheating.


Y
600
500
400
300
200
100
0
Units consumed
Tubelight
LED
1
2
3
4
5
X
Years

Topic _____ Date _____

RESULTS AND OBSERVATION

1) **Tube light :-**

- **Brightness:** Bright and steady after warm-up.
- **Efficiency:** Consumed more power relative to LEDs.
- **Color Quality:** Emits a slightly greenish hue due to phosphor.
- **Environmental:** Contains mercury, which is hazardous to dispose of.
- **Lifespan:** Average life span of 10,000 - 15000 hours

2) **White LEDs:**

- **Brightness:** Bright and consistent immediately after turing on.
- **Efficiency:** Higher efficiency, consumes less power.
- **Color Quality:** High CRI with a steady white light output.
- **Environmental Impact:** Contains no toxic materials, making it safer to dispose of.
- **Life span:** Average life span of 50,000 hours or more.

Topic _____ Date _____

CONCLUSION

In Conclusion, white LEDs demonstrate superior performance in terms of efficiency color quality, and environmental sustainability, Tube light while effective, are less efficient, consume more power, and contain toxic ~~mercury~~ mercury, which poses environmental disposal challenges. The high efficiency, longer lifespan and environmental benefits of white LEDs make them preferable lighting solution or modern applications.

Topic _____ Date _____

REFERENCES

- J. DOE, "Comparison of Fluroescent and LED Lighting," IEEE Spectrum, 2020.
- M. Singh et al., "Study of LED Technology and Applications," Journal of Light Engineering, 2019.
- N. Patel, Fundamentals of Lighting and Photometry, Light Press, 2018.