**Task A- LED Control System**

**Project Title: ESP32-Based LED Mode Controller with OLED Display**

**Introduction**

This project implements a smart LED control system using ESP32 microcontroller. The system allows users to cycle through different LED lighting patterns using push buttons while providing real-time visual feedback through an OLED display.

**Project Objectives**

- Design a system to control multiple LED patterns

- Implement user input via push buttons

- Provide real-time status display on OLED screen

- Create four distinct LED operating modes

- Ensure intuitive user interaction

**Hardware Components Used**

**Microcontroller**

ESP32 Development Board - Main processing unit

**Input Components**

Push Button 1 - Mode selection button

Push Button 2 - System reset button

**Output Components**

LED - Red indicator light

LED 2- Green indicator light

LED 3 - Blue indicator light

OLED Display (SSD1306) - 128x64 pixel display for status

**Supporting Components**

220Ω Resistors(x3) - Current limiting for LEDs

Breadboard- Circuit prototyping

Jumper Wires- Electrical connection

**System Functionality**

**Button Operations**

- \*\*Button 1 (Mode Cycle)\*\*: Press to sequentially cycle through 4 LED modes

- \*\*Button 2 (Reset)\*\*: Press to immediately return to OFF mode from any state

**LED Operating Modes**

**Mode 1: ALL LEDs OFF**

-Description: All three LEDs are completely turned off

**Mode 2: ALTERNATE BLINK**

-Description: LEDs blink in alternating pattern

**Mode 3: ALL LEDs ON**

- Description: All LEDs remain constantly illuminated

**Mode 4: PWM FADE**

- Description: Smooth brightness fading using PWM

**User Interaction Flow**

1. System Start: All LEDs OFF, OLED shows ready state

2.Press Button 1: Cycle to next mode → OLED updates

3. Repeat Press: Continue cycling through modes

4. Press Button 2: Immediate return to OFF mode

5. Continuous: Selected mode runs automatically

**Applications**

- Home automation lighting control

- Educational demonstration of embedded systems

- Prototype for smart lighting solutions

- IoT device control interface

**Conclusion**

This project successfully demonstrates a complete embedded system with user input, multiple output patterns, and real-time visual feedback. The system provides an intuitive interface for controlling LED lighting patterns while maintaining clean code structure and reliable operation.