**Title: IoT-Based Real-Time Electricity Bill Monitoring System**

**Overview:**

This project aims to design a Smart Energy Monitoring System that tracks electricity usage in real-time and calculates the estimated bill. It leverages IoT technologies to provide users with live data, usage trends, and smart alerts through a web or mobile dashboard.

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**1. Hardware Components:**

- **ESP32:** A Wi-Fi-enabled microcontroller for real-time data transmission.
- **CT Sensor (SCT-013):** Measures current flow from the main electric line.
- **Voltage Sensor (ZMPT101B):** Accurately reads voltage for power calculation.
- **OLED Display (Optional):** Displays real-time power usage and bill amount locally on the device.

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**2. Working Process:**

1. **Real-time Data Collection:** CT and Voltage sensors measure current and voltage.
2. **Power Calculation:** Power (W) = Voltage × Current
3. **Energy Units Calculation:** Energy (kWh) = Power × Time
4. **Bill Calculation:** Units × Per Unit Cost (input by the user)
5. **Data Transmission:** ESP32 sends data to the cloud (Firebase/MQTT).
6. **User Interface:** A mobile or web dashboard displays real-time electricity usage and estimated bills.

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**3. Key Features:**

✅ Daily, Weekly, and Monthly Consumption Reports

✅ Budget Limit Alerts for Over-Usage

✅ Device-wise Consumption Tracking (in advanced version)

✅ Real-Time Notifications on Mobile Devices

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**4. Technologies Used:**

- **Programming:** MicroPython / Arduino IDE (for ESP32)
- **Cloud Communication:** Firebase / MQTT
- **Dashboard:** React (Web) or Flutter (Mobile App)
- **Backend:** Node.js / Python Flask

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**Future Scope:**

This system can be extended as a Final Year Project by integrating AI-powered energy-saving recommendations, smart appliance control, and predictive analytics based on user behavior.

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