Smart Furnace Monitoring & Optimization using IoT

for Inconel 718 Heat Treatment

Objective:

To integrate IoT-based real-time temperature monitoring into the Nano Tec Box Furnace to:

1. Optimize energy usage by automating furnace run-time.

2. Minimize manual intervention using Blynk 2.0 app.

3. Predictively manage thermal cycles for Inconel 718.

Basics You Should Know:

IoT: Smart devices connected to the internet, sharing real-time data.

Heat Treatment: Heating and cooling metals to alter properties. Inconel 718 needs precise cycles.

Components Required:

- ESP32 Dev Board - main controller

- DHT11 Sensor - temperature and humidity sensing

- Blynk 2.0 App - smartphone dashboard

- Relay Module (Optional) - for ON/OFF control

- Wires, Breadboard, USB Power

How It Works:

1. ESP32 reads temperature from DHT11.

2. Sends data to Blynk app via WiFi.

3. View status remotely and control furnace (optional).

4. Collect data -> optimize future heat cycles.

Hardware Setup:

DHT11 to ESP32:

- VCC -> 3.3V

- GND -> GND

- DATA -> GPIO 4

Relay (Optional):

- IN -> GPIO 5, VCC -> 5V, GND -> GND

Blynk Setup:

1. Go to blynk.cloud -> Create a project.

2. Add widgets: Gauge (V0), Value (V1), Button (V2), Chart.

3. Link them with ESP32 using auth token.

Estimated Energy Savings:

Assuming 8 hrs/day furnace usage:

- IoT optimization reduces unnecessary runtime by 20-30%

- Estimated savings: ~22-28%

- For 400 kWh/month -> saves ~88-112 kWh

Interview Talking Points:

- Why ESP32? WiFi + GPIO

- Why DHT11? Budget and range fit

- Metallurgical value? Enables precision and efficiency

- Energy audit and lean manufacturing compliant

Future Scope:

- Upgrade to DHT22 or thermocouples

- Add PID control for full automation

- Data logging to cloud/Sheets

- ML model for predicting cycles