Embedded Systems Intern Assignment

Problem Statement 1

A Real Time Operating System is often required when an embedded system performs various event driven functionalities and FreeRTOS is one of the most ubiquitous Real Time Operating Systems for embedded systems. This assignment involves you showcasing the know-how (or the ability to gather said know-how) of the basic intricacies of using RTOS.

Consider the following Tasks and its corresponding Task Handle:

Task Prototype	Task Handle
void ExampleTask1(void *pV);	TaskHandle_t TaskHandle_1;
void ExampleTask2(void *pV);	TaskHandle_t TaskHandle_2;

Consider the following Queue and its properties:

Property	Value
QueueHandle	QueueHandle_t Queue1;
Size of Queue	5
Data Type	Data_t

Definition of Data_t

```
typdef struct{
    uint8_t dataID;
    int32_t DataValue;
    } Data_t;
```

What is to be done:

- Create Tasks **ExampleTask1** and **ExampleTask2** as per above prototypes and handles. Priority levels of the task at your discretion.
- Create Queue **Queue1** with the above properties mentioned (FreeRTOS Queue).
- **ExampleTask1** sends data to **Queue1** at a rate of once every 500ms. The delay between each send needs to be exact. The members of the structure are populated by global variables **G_DataID;** and **G_DataValue;** Assume that these variables are updated elsewhere.
- **ExampleTask2** takes data from **Queue2** whenever data is available, and applies the following logic to the data gathered:

Condition	Action
if(dataID==0)	Delete ExampleTask2
if(dataID==1)	Allow the processing of DataValue Member
if(DataValue==0)	Increase the Priority of ExampleTask2 by 2 from the value given to it at creation
if(DataValue==1)	Decrease the Priority of ExampleTask2 **if** previously increased
if(DataValue==2)	Delete ExampleTask2

At every evaluation, add a print statement to print out **dataID** and **DataValue**.

Problem Statement 2

In this assessment, we expect you to design a reference/ evaluation PCB board based on NordicSemi's NPM1100 Power management IC. Information about the IC can be found here.

Specifications:

- Output Voltage : 3.0V

- Charge Current: 200mA (at CC).
- Relevant IO from the power management IC to be exposed to host MCU. (Simple pin headers are enough).
- LEDs to indicate Power and Charging.
- Use NPM1100 QFN24 Package.
- All SMD components to be top mounted.
- Maximum of 4 layers.
- BOM to be prepared. (You may source from anywhere, LCSC recommended).
    - BOM need only contain the following:
        - Part Designator as per Schematic.
        - Qty
        - Part Number as per Sourcing (eg: Mouser SKU, LCSC Part Number etc..).
- **Bonus**: Include relevant circuitry to measure Battery Voltage using the host MCU.
- PCB size not to exceed 35mm x 35mm.

Restrictions:

- Use only open source PCB design suite (eg, KiCAD).
- Do not use SMD components smaller than 0403, and larger than 0805.
- Input via 2 pin header, assume ripple-free 5V input capable of 1A.

Submission Instructions

Expected Outputs:

- Problem Statement 1:
    - Code uploaded in GitHub, same link (git repository) for both problem statements. Any other form of submission will not be accepted (google drive, direct file share, etc).(share the link using the submit assignment feature in Internshala).
- Problem Statement 2:
    - Upload Schematic, and PCB files in PDF format **(do not submit gerbers)** in the same Git Repository. Any other form of submission will not be accepted (google drive, direct file share, etc).
    - Upload BOM in CSV, or Excell format.

Evaluation Criteria:

- Problem Statement 1:
    - Logic used.
    - Coding Standards.
    - Error free code.
    - Usage of comments.
- Problem Statement 2:
    - Clean Schematic diagram with proper Labeling.
    - PCB routing techniques used.
    - Adherence to restrictions on design and component selection.
    - Placement of silkscreen and components on PCB.

This is how your git repo structure should look like:

```
├─── ProblemStatemet1/
|    ├─── main.c    // File containing answer to prob 1
|    └─── readme.md  // Optional if you wish to explain your code.
└─── ProblemStatemet2/
   ├─── Schematic.pdf
   ├─── pcb_design.pdf
   ├─── BOM.csv
   └─── readme.md  // Optional if you wish to explain your work.
```

Note: If you need clarification on the problem statements reach out to me on internshala chat.

Good luck :)