1 part one

1.1 LED Current Calculation

I've got a high-power $12V$ LED with a 3.3Ω resistor. Using Ohm's Law, I find that the LED draws about $3.64A$ of current.

1.2 Energy Requirement

I want to power this LED for more than 5 hours. So, I calculate the energy needed using the formula:

$$Energy\ (Wh) = Power(W)\ x\ Time(h)$$

The LED consumes roughly $43.68W$, and I want it to run for 5 hours, giving me an energy requirement of about $218.4Wh$.

1.3 Battery Capacity

My $5200mAh3SLiPo$ batteries are rated at $11.1V$. I convert the battery capacity from mAh to Wh using the formula:

$$Battery\ Capacity(Wh) = \frac{Battery\ Capacity(mAh)\ x\ Battery\ Voltage}{1000}$$

. This results in each battery having approximately $57.72Wh$ of capacity.

1.4 Number of Batteries Needed

To find out how many batteries I need, I divide the energy requirement by the battery capacity:

$$Number\ of\ Batteries = \frac{Energy\ Required}{Battery\ Capacity(Wh)}$$

. This calculation indicates I need about 3.78 batteries. Since I can't have a fraction of a battery, I round up to 4.

So, in summary, I'd need 4 of these $5200mAh3SLiPo$ batteries connected in parallel to power my LED for more than 5 hours.

2 part two

2.1 Cell Voltage Monitoring

The BMS should monitor the voltage of each individual cell within the batteries. This can be achieved using voltage sensing circuits connected to each cell.

2.2 Voltage Balancing

If the BMS detects a significant voltage difference between cells or batteries, it should actively balance the voltage. This is typically done by dissipating excess voltage from the higher-voltage cells through resistors or other balancing circuits.

2.3 Overvoltage Protection

The BMS should include overvoltage protection to prevent any cell or battery from charging to a dangerous level. If a cell reaches its maximum safe voltage, the BMS should disconnect it from the charging source.

2.4 Undervoltage Protection

Conversely, the BMS should have undervoltage protection to prevent cells or batteries from discharging to a level that can damage them. If a cell reaches its minimum safe voltage, the BMS should disconnect it from the load.

2.5 Current Limiting

The BMS should include current limiting to prevent excessive discharge or charging currents that can damage the cells or create unsafe conditions.

2.6 Temperature Monitoring

Temperature sensors should be integrated into the BMS to monitor the temperature of the cells. If a cell gets too hot, it may indicate a problem, and the BMS should take appropriate actions, such as reducing charging or discharging rates.

2.7 Communication and Data Logging

The BMS should be able to communicate with an external controller or display to provide real-time information about the battery pack's status. It should also log historical data for analysis and diagnosis.

2.8 Safe Disconnect

In the case of a severe fault or overcurrent condition, the BMS should have the capability to disconnect the entire battery pack from the load to prevent damage or hazards.

2.9 User Alerts

The BMS should have the ability to provide visual or audible alerts to the user or operator in case of a fault or hazardous condition.

2.10 Redundancy and Fail-Safe Features

To enhance safety, consider redundant circuits and fail-safe mechanisms to ensure that even if one part of the BMS fails, it doesn't compromise the overall safety of the battery system.