TASK1.3- Box of Shame

Case Analysis:

- For determining how many batteries we need to connect in parallel so that the led keeps lighting up for at least 5 hours, first we need to calculate the current to be driven for the led which from ohm's low we get (with considering the LED to be ideal) V=IR with V = 11.1 v (nominal voltage) and R = 3.3 ohm we get **I= 37/11 amps**.
- Therefore, after calculating the derived current, the 80C LIPO battery of capacity 5.2 Ah drives 5.2 amps for 1 hour ideally but actually this will not be the actual capacity. So, we need to consider having from **75-80%** of the actual capacity and make our calculations on. Considering **75-80%** of the actual capacity means having relatively from 3.9 Ah to 4.16 Ah of capacity. By multiplying the calculated current by 5 (the 5 hours) we get **37/11 * 5 = 16.82 Ah**, and hence by dividing **16.82 Ah on the range from 3.9-4.16 Ah,** we get that we **need at least 5 batteries** so that the Led keeps lightening up for at least 5 hours.

Bonus:

- BMS is an abbreviation for battery management system. A BMS is mainly made to maintain our battery systems in general through:
    - Monitoring battery cells and balancing them through charging and discharging.
    - Maintaining and determining SOC and SOH.
    - Manage the dissipated power and provide a thermal management system.
    - Maintain the safety of the vehicles.
    - Identify the faults and record it to be corrected later.
- The cell balancing is one of the major functionalities that BMS provides and it means balancing the voltage among the available cells through charging and discharging. There are two techniques available for cell balancing which are:
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	Passive cell balancing	Active cell balancing
	It depends on getting rid of energy by dissipating it through external resistors till the whole cells reach equal energies.	It depends on transferring energy among cells with higher energy to lower ones through energy storing elements such as capacitors or inductors.
Pros	- Simple design - Cost effective	- Less wasted energy - SOC of the cells pack equal to the average
Cons	- Cells are limited to the cell with the least energy. - Energy lost in form of heat. - Cooling system is needed	- Complex design. - Additional cost is needed

- Another thing BMS provide is battery thermal management due to the dissipated power in the form of thermal energy. The battery thermal system maintains cells at their optimum temperature to keep it in a safe condition. It has four major functions which are:
  - Cooling
  - Heating (in case of cool environment).
  - Isolation (to prevent sudden change in temperature).
  - Ventilation (to get rid of hazardous gases results from the cells that may cause problems)

The following is a diagram for the internal design of a BMS Circuit that provides the major functionalities that stated above and needed from such a system: