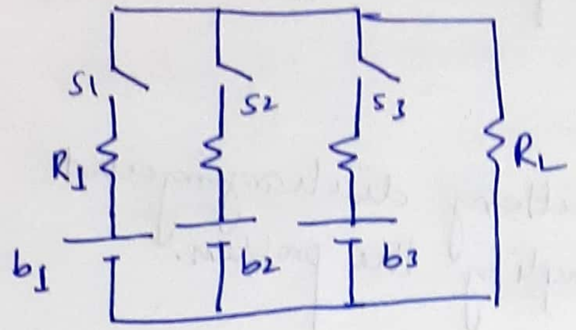
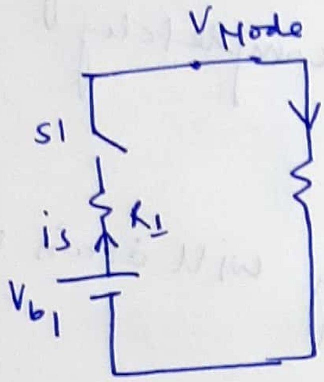
BATTERY BALANCING



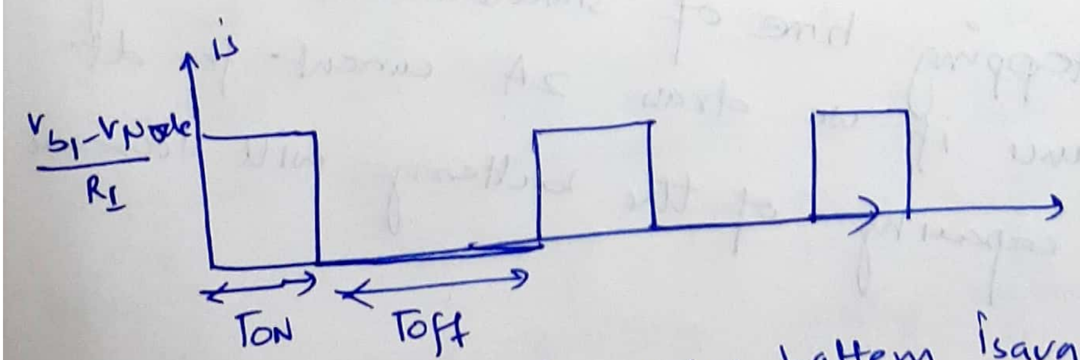
Lets :- Consider a simplified circuit to understand the concept of effective Resistance.



Lets Assume we want Node voltage to be constant at VNode volts then the current coming out of the battery would be

$\frac{V_{b1} - V_{Node}}{R_1}$ → when switch is closed

0 → when switch is closed



Average current Delivered by battery $i_{s_{avg}} = \underbrace{\left(\frac{T_{ON}}{T_{ON} + T_{off}}\right)}_{\text{dutycycle}} \times \frac{V_b - V_{Node}}{R_1}$

$$\therefore\ i_{s\,avg} = d \times \frac{V_b - V_{Node}}{R_1} \quad \text{or} \quad \frac{V_b - V_{Node}}{(R_1/d)}$$

effective Resistance seen by the Load

Hence we can say that by setting the switching frequency of the switch we can vary the effective resistance of the circuit.

→ Same concepts selected to the battery discharging and same assumptions made to simplify the problem.

Suppose battery capacity is given as 5Ah (Ampere hours)

⇒ If 5A current is drawn from the battery then it will take 1 hours to completely discharge it.

hence if 2A is drawn then the battery will drain in

$$5A \longrightarrow 1\,hr$$

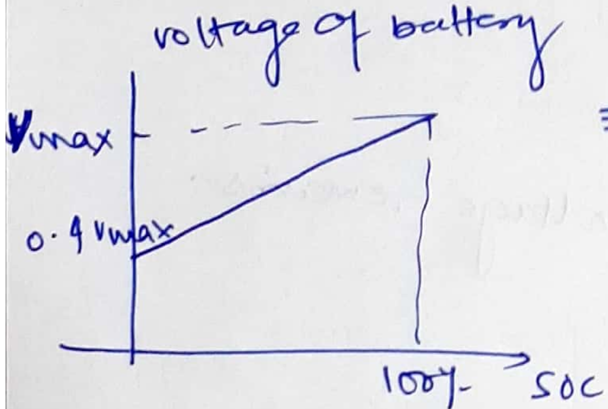
$$2A \longrightarrow \frac{5}{2}\,hrs$$

Assuming stepping time of simulation to be very small dt Hence if we draw 2A current for dt time then capacity of the battery will decrease from

$$5 - \frac{5}{2} \times dt \ \text{Ahr}$$

$$\text{percentage of battery Remaining} = \underbrace{\frac{5 - 5/2 \times dt}{5}}_{\text{Remaining capacity}} \times 100$$

Now, there is a concept of SOC (State of charge)
There is a Relationship between voltage of battery & SOC ~~where~~ which we are assuming here to be Linear.



$\Rightarrow$ eqn

$$V = V_{max}\left(\frac{SOC \times 0.6}{100} + 0.4\right)$$

→ SOC can be considered as Battery capacity only
have in our case & capacity remaining is (SOC)

$$\left(5 - \frac{5}{2} \times dt / 5\right) \times 100$$

$$\therefore \; V = V = V_{max}\left(\frac{\left[\left[5 - \frac{5}{2} \times dt\right] / 5\right] \times 100 \times 0.6}{100} + 0.4\right)$$

Process followed:-

Which ever cell has max voltage, we will discharge it first.

suppose B1 14.3   B2 : 12.3   B3 : 11.6

More

So discharge it such as Node voltage remains whatever we need.

$$i_{savg} = \frac{V_b - V_{Node}}{R_1/d} = \frac{V_{Node}}{R_L}$$

eg.

$$d\left(\frac{14.3 - 8^{(say)}}{2^{say}}\right) = \frac{8}{100}(say)$$

$\therefore d = 0.025 \leftarrow$ this duty cycle must be kept ?

So at any instant of time only 1 cell will be connected to the circuit and after dt (stepping time) algorithm will evaluate which cell has max voltage hence will discharge it first by connecting it to the circuit and setting duty cycle of the switch such that we get the Required Node voltage.