HEV - END SEMISTER EXAM.

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Q②:

i) Burp charging :

→ Burp charging is also called as Reflex or negative - Pulse charging.

→ Burp charging is used in conjection with Pulse charging. A short pulse with 2 to 3 times the charging current is applied with negative polarity for 5 msec. During this period, which is called charging rest period which helps to depolarize the cell.

→ These negative pulses remove any gas bubble created during fast charging process. By removing these gas bubbles, the stabilization of cell increases, which ultimately improve the process of charging.

→ The release and diffusion of gas bubble is known as burping, and hence the name.

→ Burp charging does not damage the battery.

ii) IUI charging :

→ IUI is latest technology used for fast charging the lead acid batteries from particular manufacturers.

→ It is not suitable for all lead-acid batteries.

→ In IUI charging, Initially the battery is charged using constant current (I), until the cell reaches the pre-set voltage value.

- When preset voltage value reached, the ~~ch~~ battery is charged with constant voltage (V), therefore current drawn by the battery will reduce until it reaches another pre-set value.

- After reaching pre-set value, again the battery is charged with constant current (I), therefore voltage will rise to it's rated value.

- The last phase is used to equalise the charge on each cell in the battery to extent the Max. life of the battery.

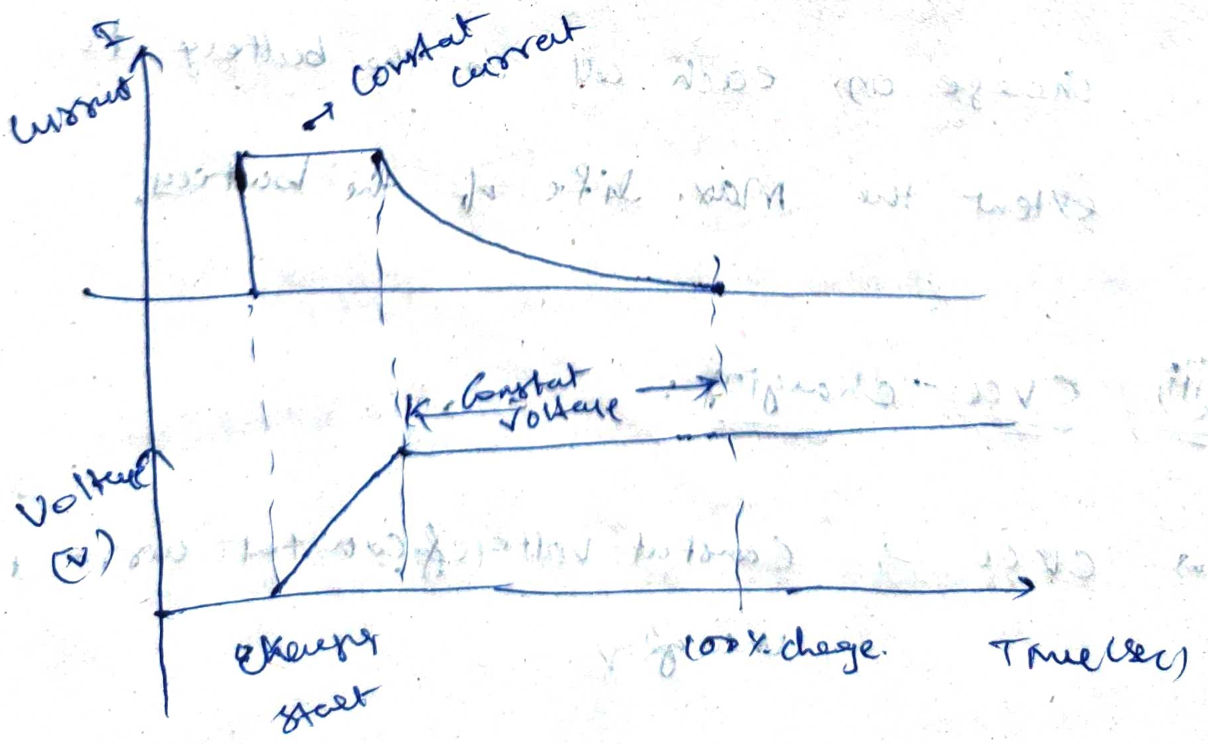
iii) <u>CVCC charging</u>:

- CVCC → constant voltage & constant current charging.

⇒ In this method, Initially battery is charged with constant current until the battery voltage reaches to a certain pre-set value.

⇒ After reaching to pre-set value of voltage, it ~~then~~ is then charged with constant voltage, therefore current will reduce.

⇒ This CVCC method charging allows fast charging, without the risk of over-charging.



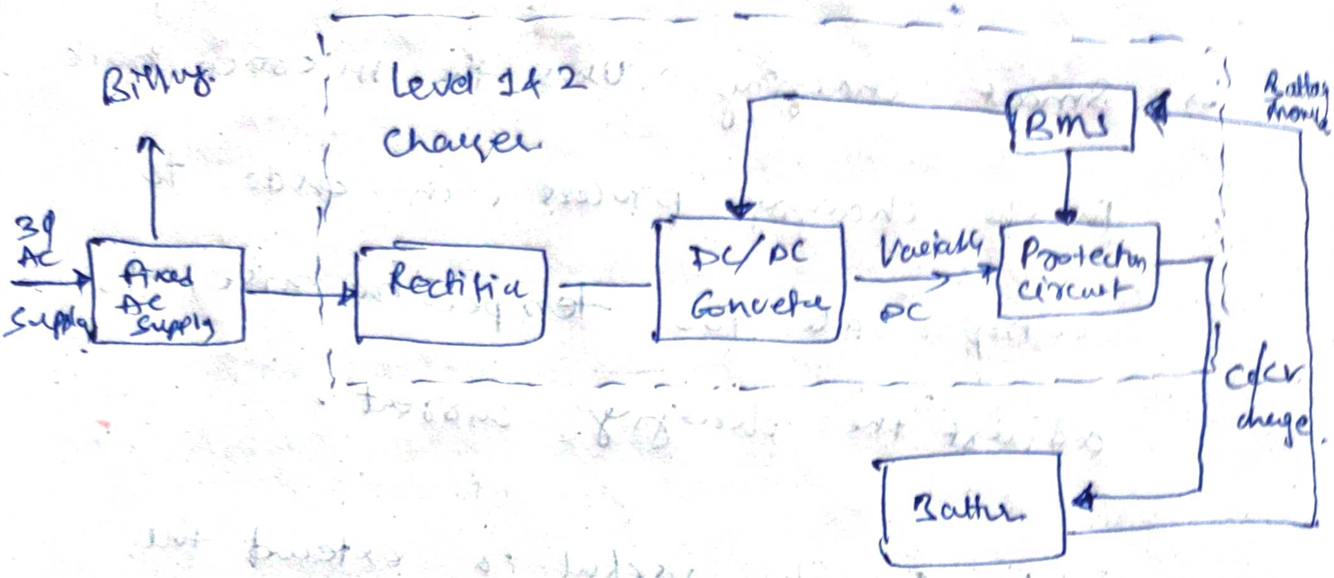
iv) Smart charging :-

→ Smart charging uses the microcontrollers in the charging process, in order to compensate for temperature rise, to adjust the charging current.

→ This can be useful to extend the life of batteries.

→ This method mainly uses for Li-Ion batteries.

Q③: Block diagram of Level 1 & Level 2 charger:



Level 1 Charger:

→ They are mainly for residential use.

→ Level-1 charger are provided by manufacturers along with EV, to charge vehicle at ~~hot~~ their homes.

→ Therefore level-1 charges ~~can~~ works on 1-φ AC supply.

→ It takes about 17 hours to charge the vehicle at output current between ~~12A 17A~~ 12A-17A. for an EV of 24kWH

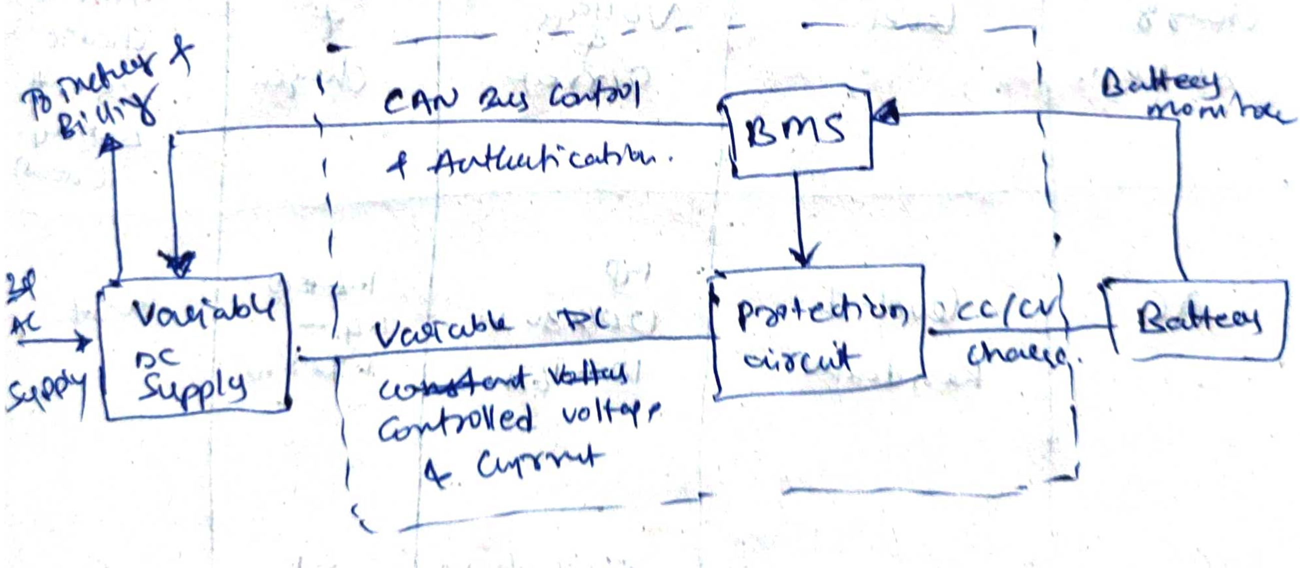
level-2 Charger:

→ level-2 chargers ~~can~~ can be installed at houses or can be used in public charging stations or commercial charge stations.

→ These chargers can provide upto 80A current due to it's high input voltage.

→ It can charge an EV of 24KWH in ~~8~~ 8 hours.

Block diagram for level-3 charger:-



Level-3 Charger:-

→ These chargers are meant for public charging stations alone.

→ level-3 chargers are also called as super chargers.

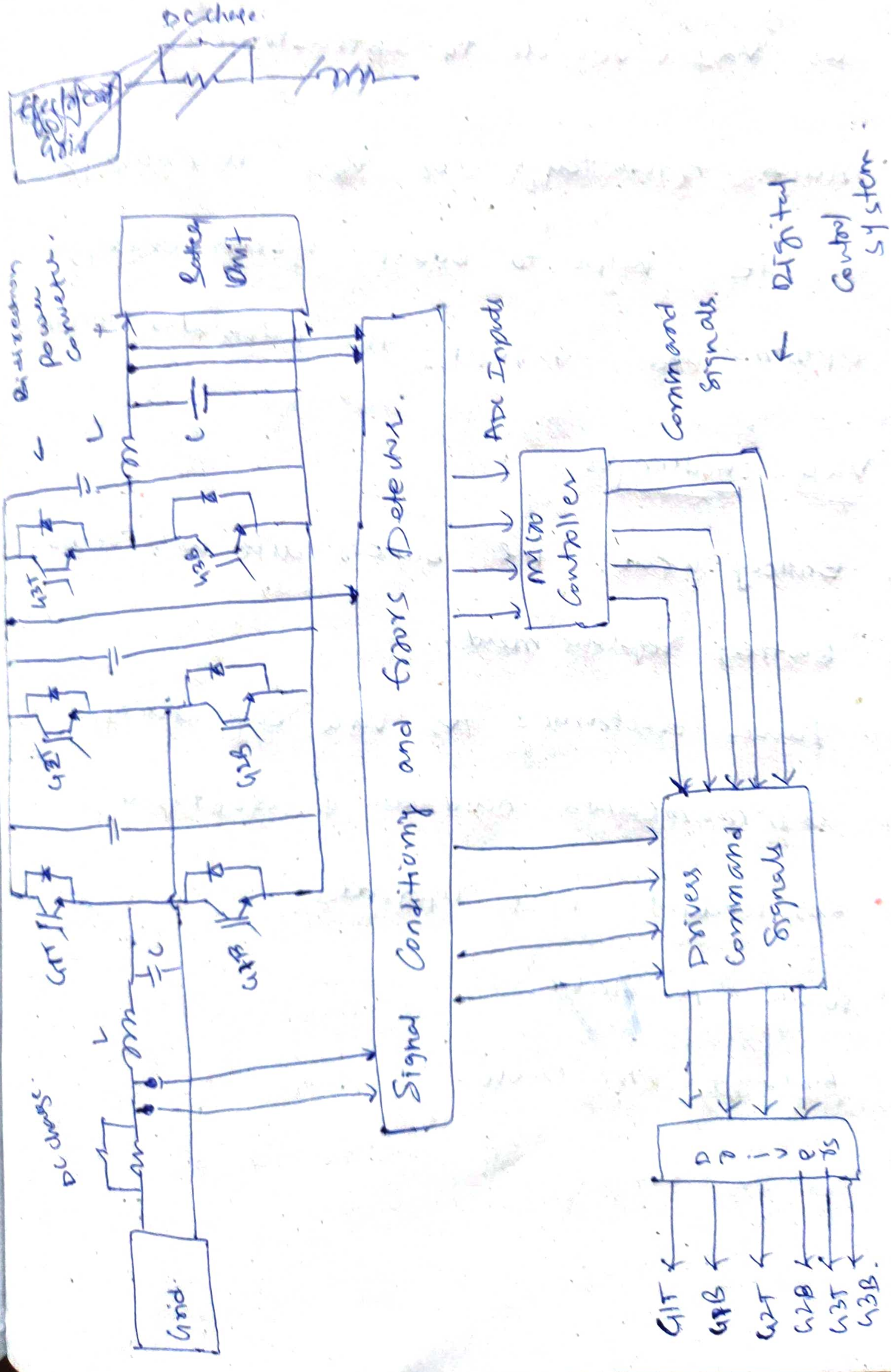
→ These chargers require a 3φ supply from grid, and can consume more than 240kW.

→ These chargers require a special permission from the grid to operate because high power consumption.

→ Power & Time Consumption for level-1, 2 & 3 Charger :-

Type of Charging Station.	Charger level.	AC supply Voltage & Current	Power of Charger.	Time to charge 24kWH Battery (Hours)
AC	level-1 Residential.	1-φ 120/230 V. 12-16A	~~1.4kW~~ 1.4-1.92kW	~17
AC	level-2 Commercial.	Split phase 208/240V 15-80A	3.1-19.2kW	~8
DC	level-3 Public charger	1φ-~~3φ~~ 300-600V ~400A	120kW to 240kW	~30

Q9: Configuration of EV charging supply equipment from Grid :-



Q(5): Benefits of V2G Technologies :-

→ V2G (Vehicle to Grid) also can be called as V2I (vehicle to Infrastructure).

→ Main Advantages of V2G technology is, its helps to boost green energy options and disrupt the automotive industries.

V2G - challenges :

i) Battery wear. i.e battery life will reduce.

ii) Battery replacement.

iii) Power electronics for V2G capability,

iv) Communication hardware & software,

v) Residential EVSE upgrades.

vi) Power Available,

vii) Energy Available.

Q(6): Let the Battery rating is

120V, 25 K VA hr

$\Rightarrow \frac{25\text{ K VA hr}}{120}$

$\Rightarrow$ 208.33 kAhr.

$\therefore$ Battery rating 120V, 208.33 kAhr.

$\Rightarrow$ For this battery to be charged from 0% to 100% in 30 min, the power required is $P = \frac{E}{t}$ $E = P$

$$P = \frac{25 \times 10^3 \text{ Whr}}{0.5 \text{ hr}}$$

$$\underline{\underline{P = 50 \text{ kW}}}$$

$\therefore$ Supply (DC) ~~sup~~ provided to Battery.

$$I = \frac{P}{V} = \frac{50 \times 10^3}{120} = 416.667 \text{ A}.$$

which is very high, practically not possible with such high current.

$\Rightarrow$ Battery would be reducing it's life when we operate which such high current very often.

Q. ① Given

100% SoC = 85 kWh.

DOD = 20% to 100%.

Battery Pack has 96 cells/ string with 74 parallel strings.

Cell voltage (no load) = 3.64 V

R_{cell} = 65 mΩ.

i) Battery terminal voltage;

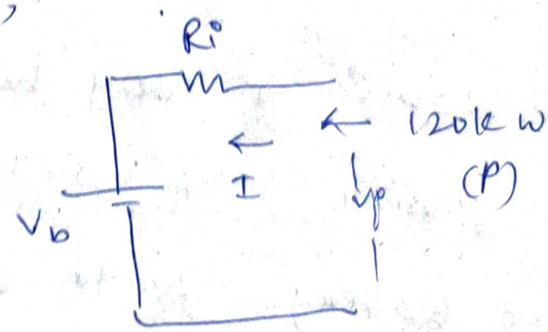
No-load Voltage (V_b) = 96×3.64

$= 349.44$ V.

Total internal Resistance (R_i) = $\frac{65 \times 10^{-3} \times 96}{74}$

$= 0.08432\ \Omega$.

At 120 kW charging,



from circuit,

$120 kW = I^2 R_i - I V_b$

$\Rightarrow I^2 R_i - I V_b - P = 0$

$$I = \frac{V_b - \sqrt{V_b^2 + 4R_i P}}{2R_i}$$

$$= \frac{349.44 - \sqrt{(349.44)^2 + 4(0.08432)(120000)}}{2 \times (0.08432)}$$

$\Rightarrow I = -318.87\ A.$

$\Rightarrow$ from circuit, terminal voltage (V_t)

$$V_t = V_b - IR_i$$

$$= 349.44 - (-318.87)(0.08432)$$

$$V = 376.32V$$

$\therefore$ Efficiency (η) $= \frac{349.44}{376.32} \times 100 = 92.85\%$

ii) Given DOD = 100% to 20%.

$\Rightarrow$ 80% of SOC $= 0.8 \times 85$ kWh

$= 68$ kWh.

$\Rightarrow E = Pt \Rightarrow$ time $= \frac{E}{P} = \frac{68\ kWh}{120\ kW} = 0.566$ hrs

$\Rightarrow$ 0.566 hrs = 0.5667×60 min

$\simeq$ 34 min.

Q(7): Given, kmph = 35,

Torque = 20 N-m.

wheel diameter = 8 inches. = 8 × 0.0254

To convert kmph to RPM = 0.2032 m.

We have RPM

$$RPM = \frac{kmph}{0.1885 \times D(m)} = \frac{35}{0.1885 \times 0.2032}$$

$$N = 913.76 \text{ RPM}.$$

we have $\omega = \frac{2\pi}{60} \times N.$

$$= \frac{2\pi}{60} \times 913.76$$

$$\omega = 95.689 \; s^{-1}$$

∴ Power required (P) = Tω

$$= 20 \times 95.689$$

mechanical power = 1913.778 W.

Given motor has 85%. efficiency.

⇒ motor rating $= \frac{1913.778}{0.85} = 2251.50 \text{ W}$

$$= 2.251 \text{ kW}$$

$\Rightarrow$ motor hp rating $= \dfrac{2251.50}{746}$

$= 3.01$ hp motor is Required.

Given, the vehicle has to run 3 hrs continuously,

$\therefore$ Total energy required for 3-hrs

$= \dfrac{2251.50}{0.85} \times 3$ Wh

$\rightarrow$ Power Converter efficiency is taken as ~~0.85~~ 85%

$= 7946.47$ whr or 7.946 kwhr.

a. for Battery of 48V,

Ah rating $= \dfrac{7946.47}{48}$ Ah.

$= 165.55$ Ah.

i) Ah rating for 48 V battery $= 165.55$ Ah.

ii) motor size $= 3.01$ hp motor.