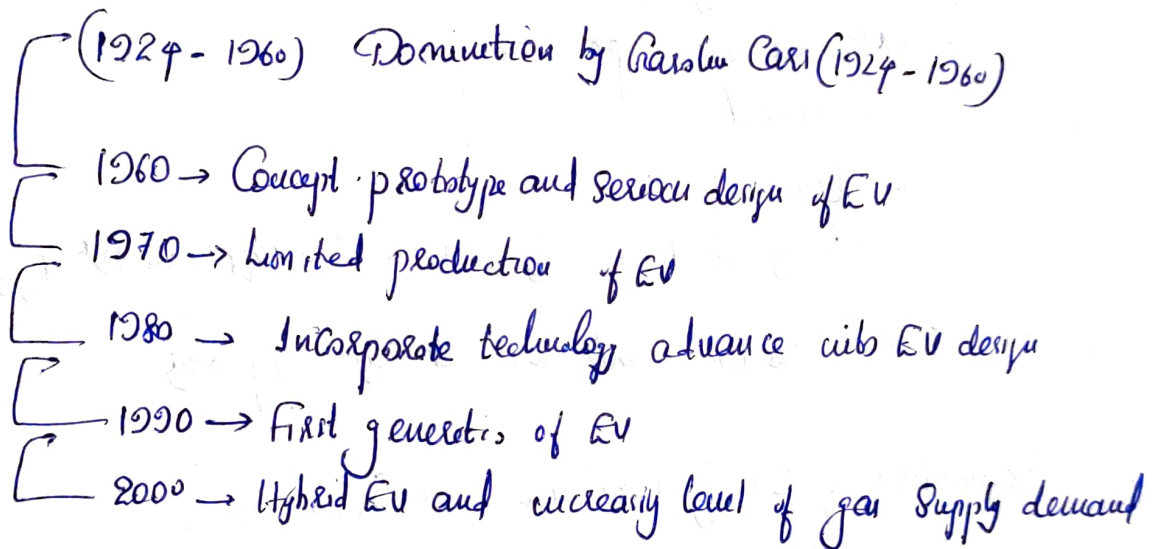
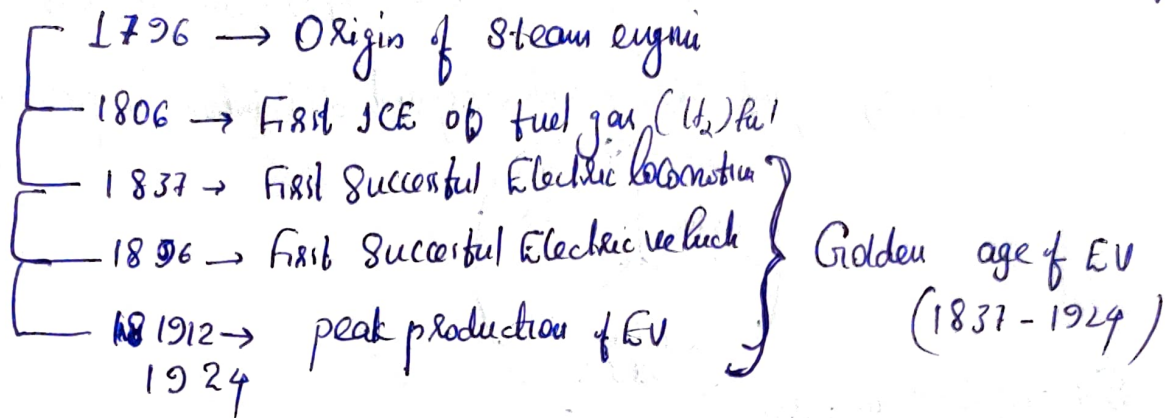
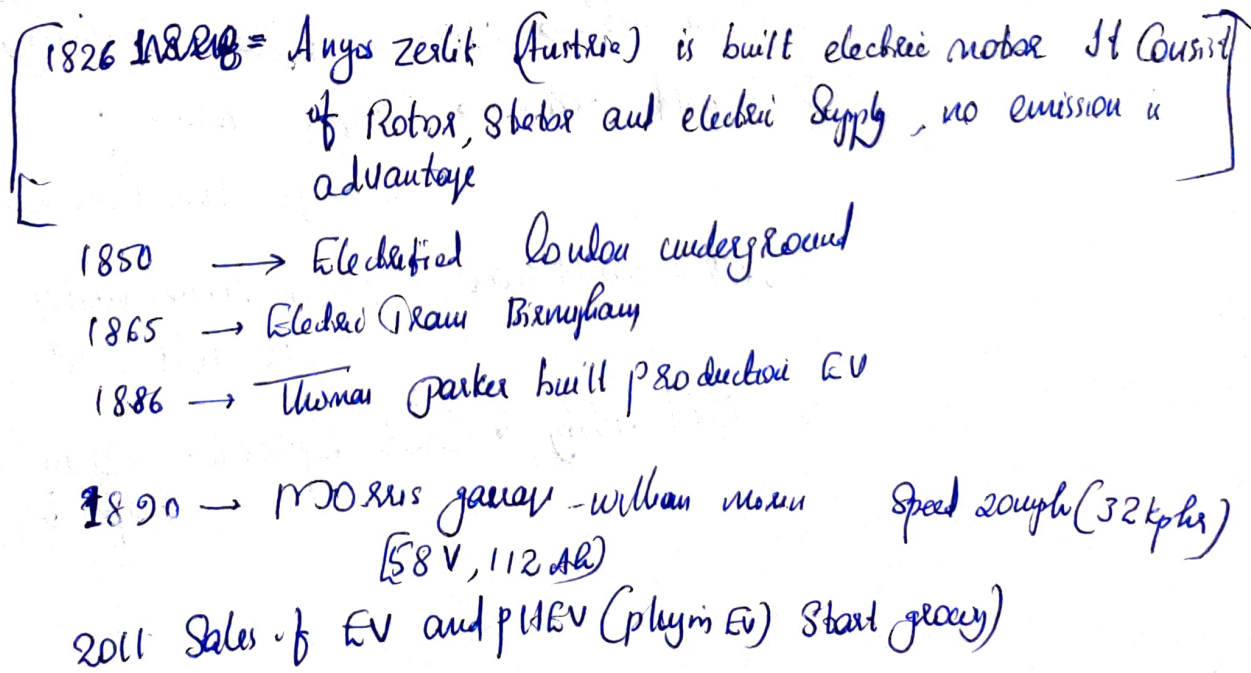


21

Flow chart of Automotiv

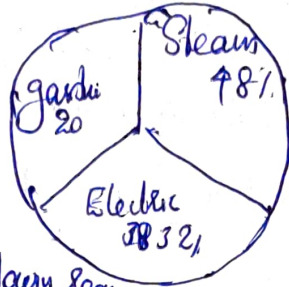
Bipin U.B
A's APInvention of Electric motor

2

Golden Era of EV (1837-1924)

1906 - 100 miles range vehicle (45-50 kmph) also present

19th Century begins (1901) vehicle Categorical distribution in percentage



EV popular due to battery range

→ No emission operation

→ efficient

→ low cost

→ Easy start → Early start in advantage in 19th century

After 1910 → Electric vehicle start decrease popularity

3 Domination of EV by Gasoline car (After 1910)

1. Henry Ford → Introduction of Assembly line technique

bring down of Gasoline cost of production decrease

2. Chevrolet → 1912 - Self start technology invention

3. World war → Range of vehicle is an ~~un~~unavoidable
charge time (Reliability issue)

4. After world war it show more faster road movement
it don't need EV during that time

5. Oil lobby → Great depression cause business operation
shaped for industries

Coming of New Era in EV

After 5th dec to 9th dec 1950 in London (Arab Smg) and 1960 City of California issue

California issue caused creation of CARB (California Air Resource Board)
In india only standard emission regulation 2003/2009

1970 to 2000 Come up with new regulation in every 10 years

1991 ~~1990~~ → CARB Come up with regulation of Low emission vehicle (LEV-I) (1993-2003)
LEV-II

Every manufacturer to provide an ev alternative to
If they want to sell vehicle in California So that ^{market} can
introduction to ev alternative especially (GMEV, Range Rover, Ev, Toyota
1999 Lev II withdrawn by Carb due to 1999 tribunal ~~then~~ win plus

2003 → LEV II

LEM (low emission vehicle) 10 → 15%

ULEV (Ultra low emission vehicle) 70-80%

PZEV (Pure zero emission vehicle) 0% emission

2006 → Santa Monica Autoexpo showcased
RoadStar → On Road Road star. (394 km)

2008 →

2010 → Nissan Leaf (First a ~~Hor~~ dahl 5 door hatchback)
Range Rover, A8 (130 kmph range speed)

Introduction of Hybrid EV

plug in hybrid vehicle is known as Hybrid vehicle

2018

plug in hybrid vehicle and EV ~~are~~ growth mostly depends upon Subsidizing of government support

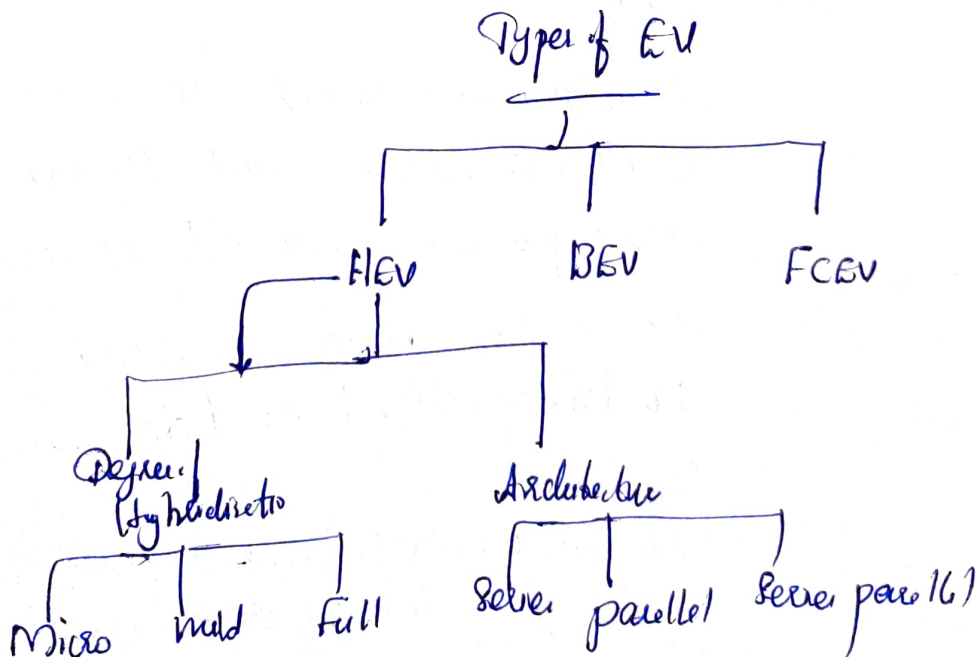
Various government Subsidies $\rightarrow$ $\text{Subsidy} = 30\%$ upto
for individuals Green credit (mainly loan interest terms)
(For by China, and Europe) Recharge Subsidy (upto 2017)

and Various Corporate Credit Schemes for Corporate purchasers (Tax, Contracts)

Lithium ion battery price drop reduce cost of cell which makes more affordable. Consider 2010 to 2020 down 87% in terms of price

Energy density of battery has almost tripled since 2010

Charging in case of Hybrid vehicle is more efficient than more flexible



Mild Hybrid

Mild Hybrid

Full Hybrid

1 Less than 1 kWh

Less than 2 kWh

2 kWh
2-10 kWh

12-48V

48V-200V

200V - 400V

2 Easy start/stop possible
Easy stop possible

Start/stop possible

Start/stop possible

3 Small regenerative
brake

No mild regenerative
brake

Full generati.

4 No additional brake
toucher

Additional brake
toucher
incapable of
drive alone in
EV mode

Capable of drive itself
by EV motor

5 Battery charge
from grid not
possible

Grid charge not
possible

Possible then called
plug in hybrid
vehicle

6 efficiency 2-11%
motor power

10-20

> 25 (greater)

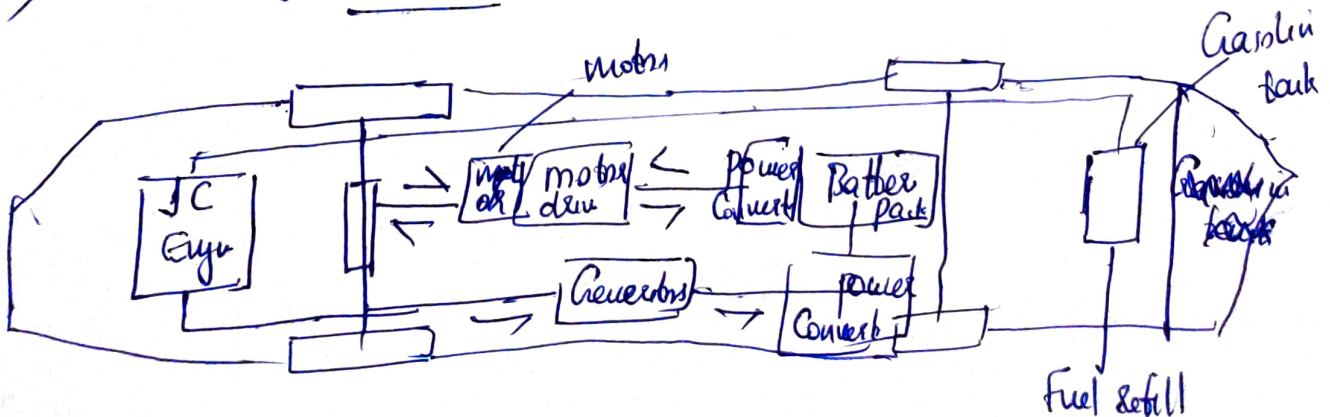
< 5

7 motor power < 5 kW
less than the

5-25 kW

10-50 kW

2 i Series Hybrid Electric vehicle



4

Series hybrid vehicle IC engine drives only generator and power generated from generator supplied to battery and ~~regenerated~~ ~~both~~ power generated from generator stored in battery in form of chemical energy and with the aid of power converter it used in motor. ~~Regen Regeneration~~ Regeneration braking energy can store in battery also

Different mode of operation

Case 1: Normal driving C

IC engine ON
motor ON

Case 2: High load

IC engine ON
motor ON

Case 3: Down braking

IC engine ON
motor ON

Case 4: Vehicle at stop

IC engine ON
motor ON

Vehicle used in series hybrid = Bmw i3

Advantages of series hybrid

- i, Mechanical decoupling b/w the ICE and driven wheels allows IC engine operate at its very optimal region
- ii, Nearly ideal-torque-speed characteristic of electric motor make multigear transmission ~~unnecessary~~ unnecessary

Disadvantages

- ~~the~~ energy overall efficiency is less (Mechanical $\rightarrow$ Electrical $\rightarrow$ Mechanical) because energy ~~transfers~~ conversion more
- Two electric machines are needed and a big traction motor is required because it is the only torque source of the driven wheels

parallel hybrid vehicle

ICE

Electric motor/Generator

Motor drive

Power Converter

Battery

Transmission

Fuel tank

Crash fault

Fault

Fuel tank

Crash fault

Fault

ICE engine and electric motor drive the

Ques 1 IC engine alone costing

IC engine $\rightarrow$ perbony din

Motor performs due
to engine Rest Condition

Case 3 Hybrid mode

IC Engine and Motor (electric) work

Case 4 Low Battery

Engine drive and charge motor

Case 5 Regenerative Braking

Battery Motor-Generator, power stored in battery

Parallel
Series parallel hybrid
Advantages

→ Both engine and electric motor directly supply torque to the driven wheels and no energy form conversion occurs hence energy loss

→ Compactness due to no need of generator and smaller traction motor

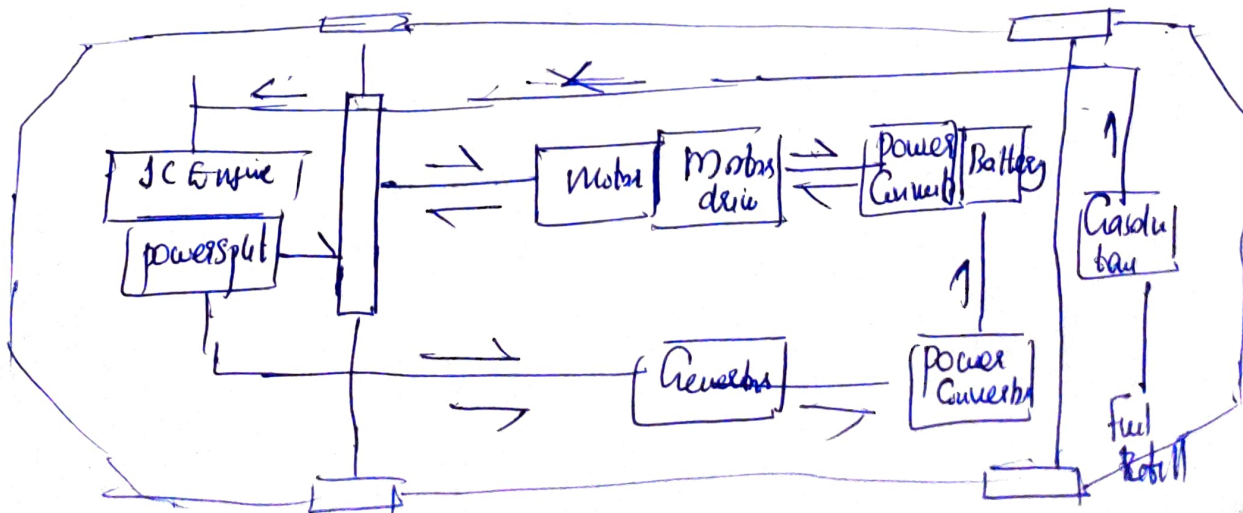
Disadvantages

→ Mechanical Coupling b/w the engine and the driven wheels, thus the engine operates only in narrow speed region

→ Mechanical Configuration and Control Strategy are Complex. Compared to Series hybrid drivetrain

3

Series parallel hybrid



Series parallel eg: (Toyota prius) first model

It In this model ICE engine drives both generator and transmission. Such way more efficient drive possible. With the aid of a power split. It can split power and to drive transmission and generator. More regenerative braking also possible. Its combination of series and parallel.

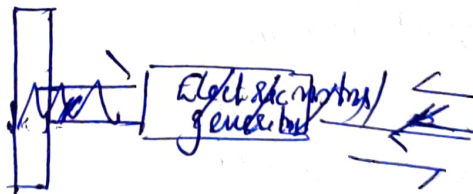
Advantages

- Have features of both series and parallel hybrid
- Many different modes of drive are possible under ICE dominant and electric motor dominant

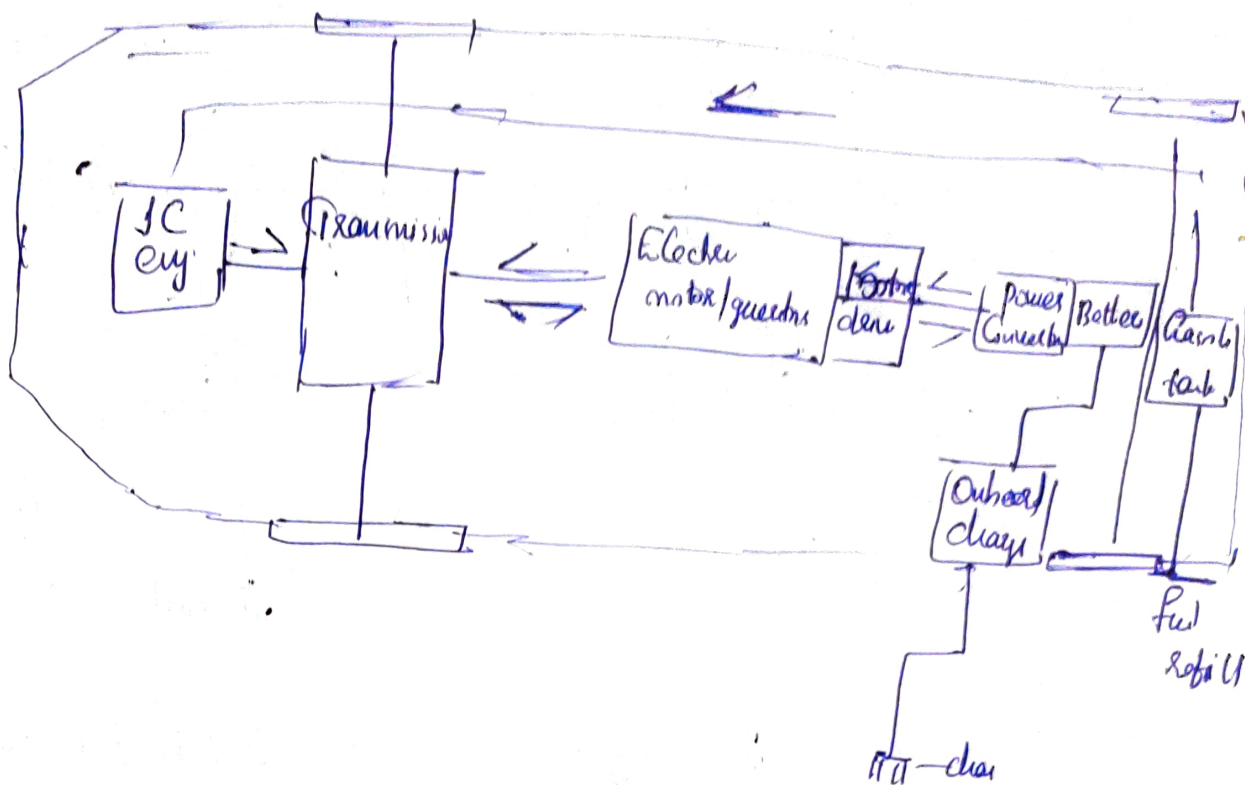
Disadvantages

- Heavy cost and more components
- Complex operation

plug in Hybrid Electric vehicle



plug in Hybrid Electric Vehicle (PHEV) eg: (BMW 330e) 6



Here IC engine and electric motor are almost independent working from their own source of energy input and fuel refill and battery charging options are here only a small energy regenerated from transmission are used for regenerative purposes
eg: BMW i8, BMW 330e

Advantages of the plug in hybrid EV (PHEV)

Zero emission on driving on battery
Fuel efficient in electric

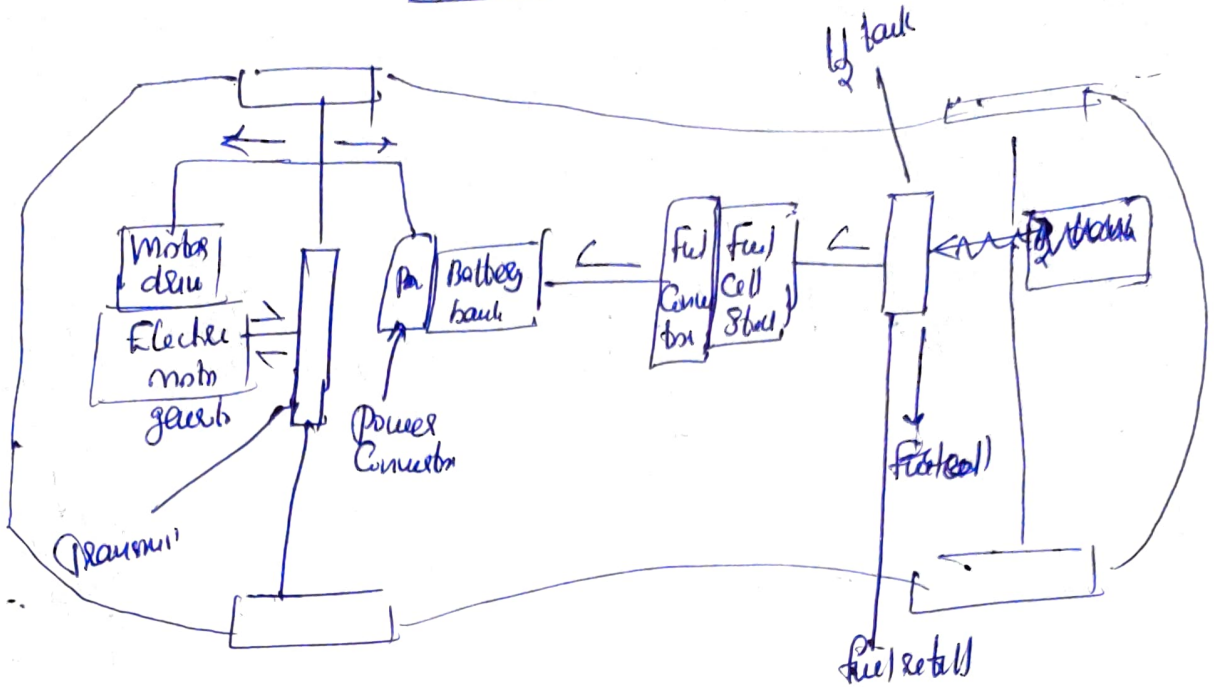
Easy to drive

Cheap to run if doing regular 10/15 miles commuter

Disadvantages of PHEV

- Expensive and Complex to maintain
- Fuel economy not good on motorway journeys
- Battery life Concern

Fuel cell EV



Here ~~major~~ source of energy from 1st source and it converted to normal battery storage form by converter and then it convert and consumed by electric motor and here regenerative energy stored in battery also. $\therefore$ 1st is considered as a future ~~energy~~ fuel

Bsp: Hyundai Nexo and Mirai (Hydrogen)

Advantages

- No No pollution
- Refill is not time taking
- More efficient than petrol and diesel, EV

Disadvantages

- Transportation of H_2 (Cryogenic temperature needed)
- Safety of storage
- Currently expensive fuel

3

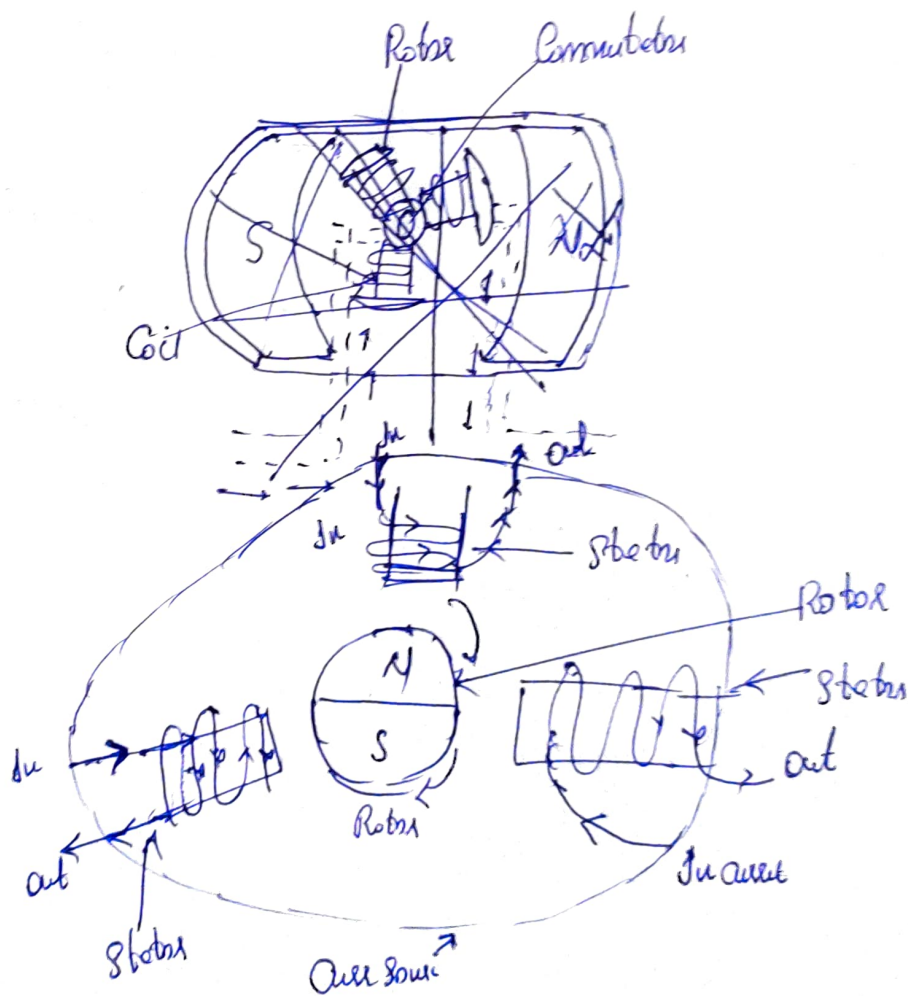
Explain with diagram the Construction & working principle of BLDC

BLDC motor

BLDC motors are used in 2W and three phase and application range upto 48 (5Kw) and maximum efficiency is 95% and minimum 35

→ As Compared to previous Construction induction and PMM motor

→ weight ~~and~~ is very less



In BLDC motor don't use brushes. BLDC motor Coils are not located on Rotor. Instead it is a permanent magnet. Coils are don't rotate but it fixed in the place on the

Stepm . Coils don't move Since no need of brushes and Commutator
 In BLDC permanent magnet that rotate Rotation is achieved by
 Changing the direction of the magnetic field generated by the Successive
 Stationary Coils . To Control the Rotation & adjust the magnitude
 and direction of the Current into these coils

→ Motor can Control Continuously at maximum Rotational force
 at even small BLDC (torque)

→ Motor Controlled by feedback mechanisms . precisely
 identify desired torque and rotational speed . It reduce
 energy consumption and heat generation . Such motor are
 battery powered

→ High durability and low noise generation . due to lack of
 brushes

It has wide range in application in future @ mobility and home
 appliances are and in future Robotics @ field and more

