. Explain the journey of automotive with the help of flow chart from the beginning of 18th century to the 21st century and give brief description on the following milestones in the automotives.

Journey :

a. Invention of Electric motor

The Hungarian inventor Anyos Jedlik invented an World's first Electric Motor ~~used~~ in 1828, and created a first small model car powered by thes Electric motor.

b. Golden Era of EV

* Because of the invention of electric moto
the golden Era of EV started from the hands o
Scottish inventor Robert Anderson, he invented a
Crude electric carriage between 1832 and 1839.

* In 1835, professor Sibrandus Stratingh of Groningen, the netherlands and his assig assistant christopher Becker from Germany also created a small-scale electric car, powered by non-rechargeable primary cells.

* A scotish chemist Robert Davidson of Aberdeen, the first known electric locomotive was built in 1837.

* The invention of improved battery technology in France 1881, Craston plante.

* In 1896 the first successful Electric vehicle was built in US by William Morisson. The EV was designed as passanger carriage driven by Driver with 2 passenger carrying capacity.

* Electric cars were labelled as Women's cars on the beginning of 1900. At that time the EV market has the share about 38% in the market when compared to other vehicles.

c. Domination of electric vehicles by Gasoline cars

* After 1910, the EV market starts to slow down and Gasoline cars started to grow.

* In 1912, Petrol - powered cars became easier to drive due to the invention of charles Kettering and his electric "starter".

* Because of that Electric cars began to lose their position in the car market at America in 1920.

* EV was Dominated by Gasoline cars from 1924-1960

d. Coming of New Era in EV.

* Because of the consecutive Domination of Gasoline vehicles, the position of EV in the market declines until the energy crises in 21 century led to renewed interest in electric cars. A lot of small companies started to design and advertise electric cars to the public.

* Toyota offered its RAV4-EVs in year 22nd November, 2002.

* Californian manufacturer of electric cars, Tesla Motors, in 2004 started the development of the Tesla Roadster model, which was first delivered to customers in 2008.

* Tesla created a bang in the EV market because of their design, efficiency in their EVs.

* Tesla was also the first to introduce lithium-ion batteries in its car production.

* In 2022, many MNC companies had taken interature for green mobility and EV vehicles such as TATA motors, Kinetic Green, Mahindra electric use such of them.

e. Introduction to Hybrid Electric Vehicles

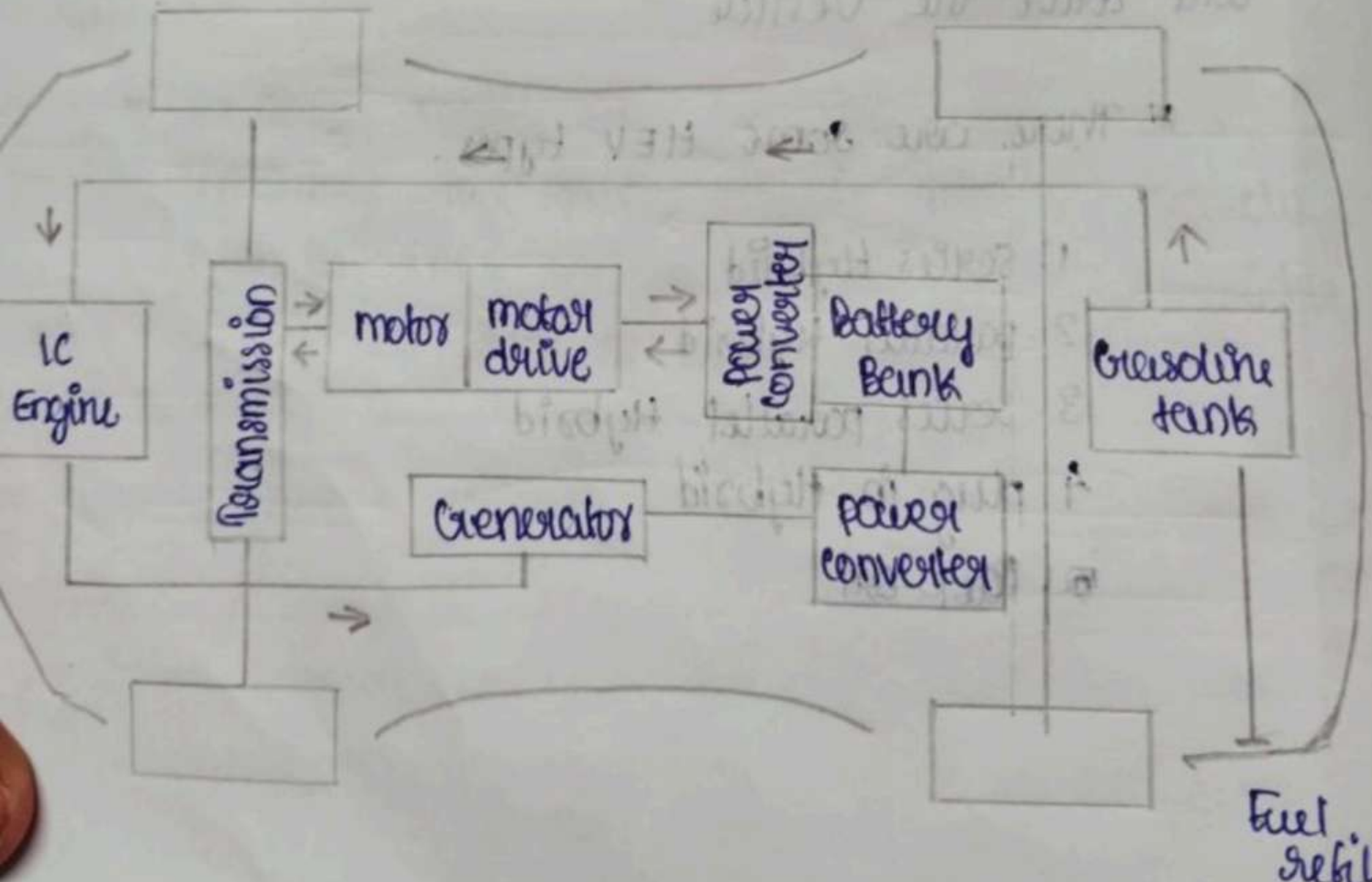
* Compared to IC Engine vehicles and Electric vehicles, Hybrid Electric Vehicles are the vehicles which have both IC Engine and Electric motor, battery combination. We can call it as more efficient IC Engine vehicle, because it increases the efficiency when comparing other IC engine vehicles.

* The primary machine will be the IC engine and Electric motor is the secondary machine both will drive the vehicle

Q2. Explain and draw the layout of following Hybrid Electric vehicles with their two Advantages Disadvantages and industrial application in automotive Segment.

a. Series Hybrid Electric vehicles

Electric vehicle fitted with IC. engine. but in this the IC engine is to generate the power to recharge the battery to drive the electric motor.



Advantages

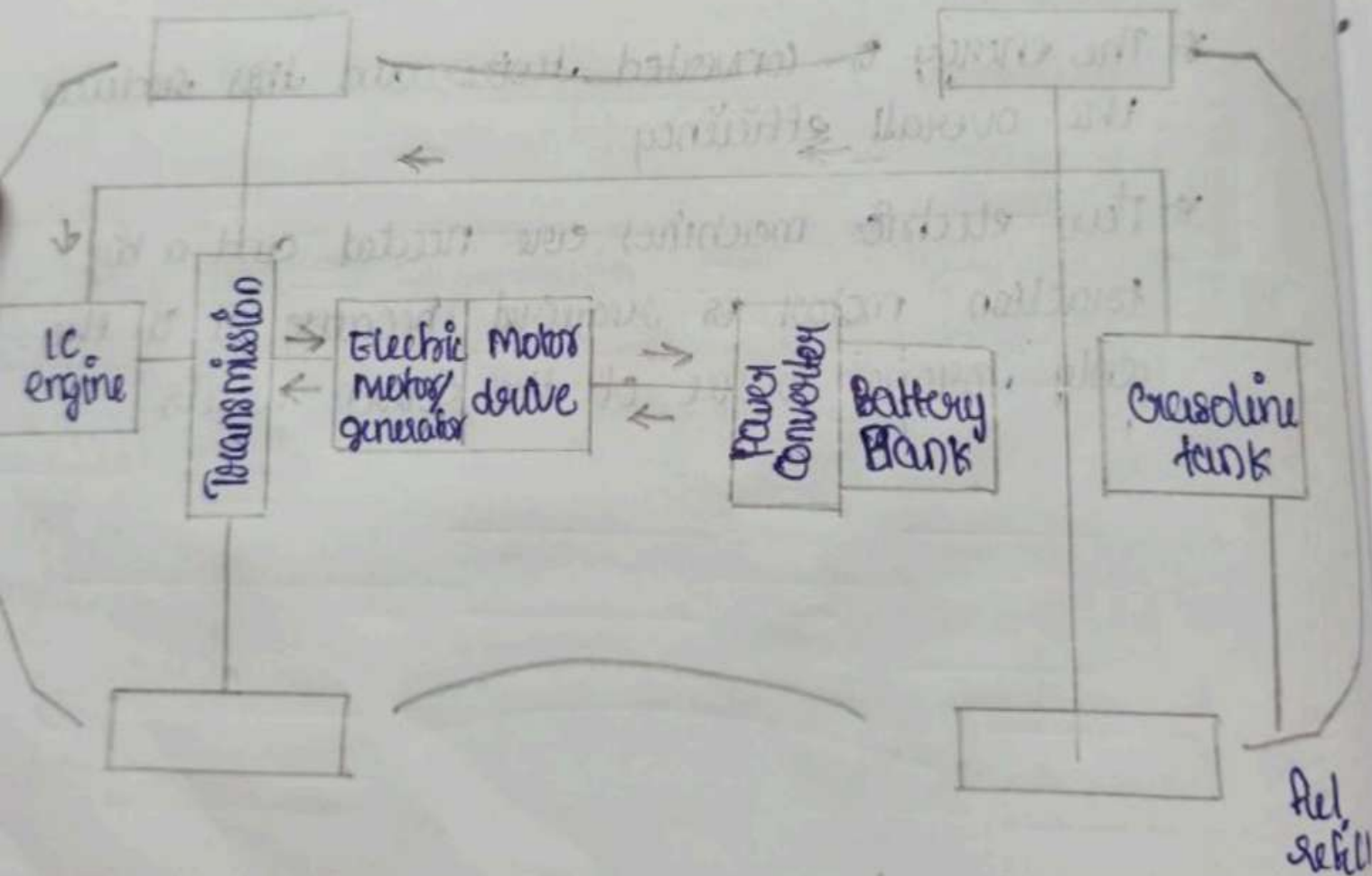
* Mechanical decoupling between the ICE and driven wheels allows the IC engine operating at its very narrow optimal region.
* Nearly ideal torque - speed characteristic of electric motor make multi gear transmission unnecessary.

Disadvantages

* The energy is converted twice and this reduces the overall efficiency.
* Two electric machines are needed and a big traction motor is required because it is the only torque source of the driven wheels.

b. Parallel Hybrid Electric vehicle

A parallel hybrid is propelled by both an internal combustion engine (ICE) and an electric motor connected to a mechanical transmission. Power distribution between the engine and the motor is varied so both run in their optimum operating region as much as possible. There is no separate generator in a parallel hybrid.



Advantages

→ Both engine and electric motor directly supply torques to the driven wheels and no energy form conversion occurs, hence energy loss is less.

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

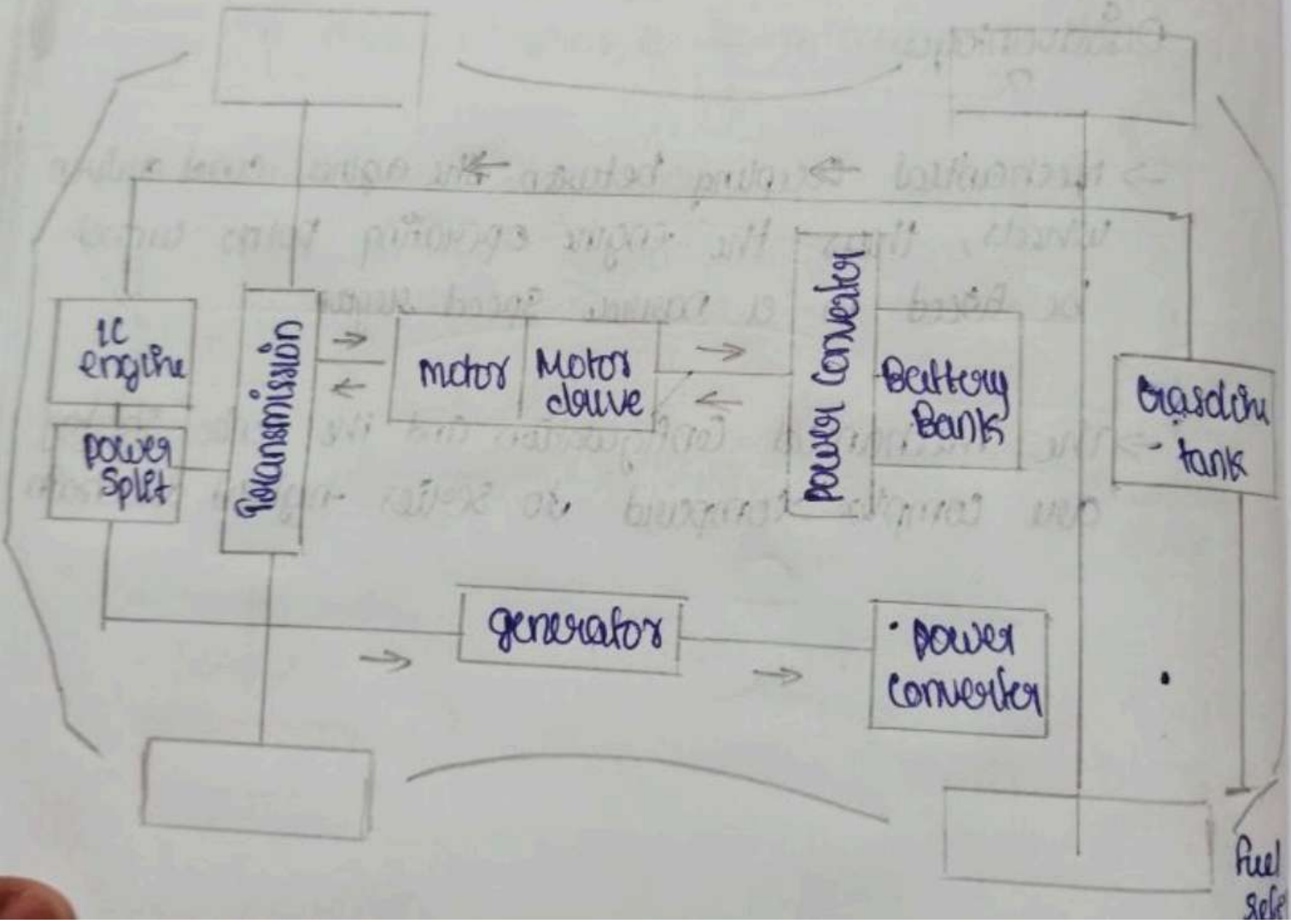
Disadvantages

→ Mechanical coupling between the engines and driven wheels, thus the engine operating points cannot be fixed in a narrow speed region.

→ The mechanical configuration and the control strategy are complex compared to series hybrid drivetrain

c. Series parallel hybrid vehicle

Similiar to series and parallel, it has electric motor and IC engine but there is a powersplit is present which allows both transmission and is also charge the battery by connecting through generator.



Advantages

-> Have feature of both series and parallel hybrid

-> Many different modes of driving are possible under ICE dominant hybrid vehicle and under motor dominant drive mode.

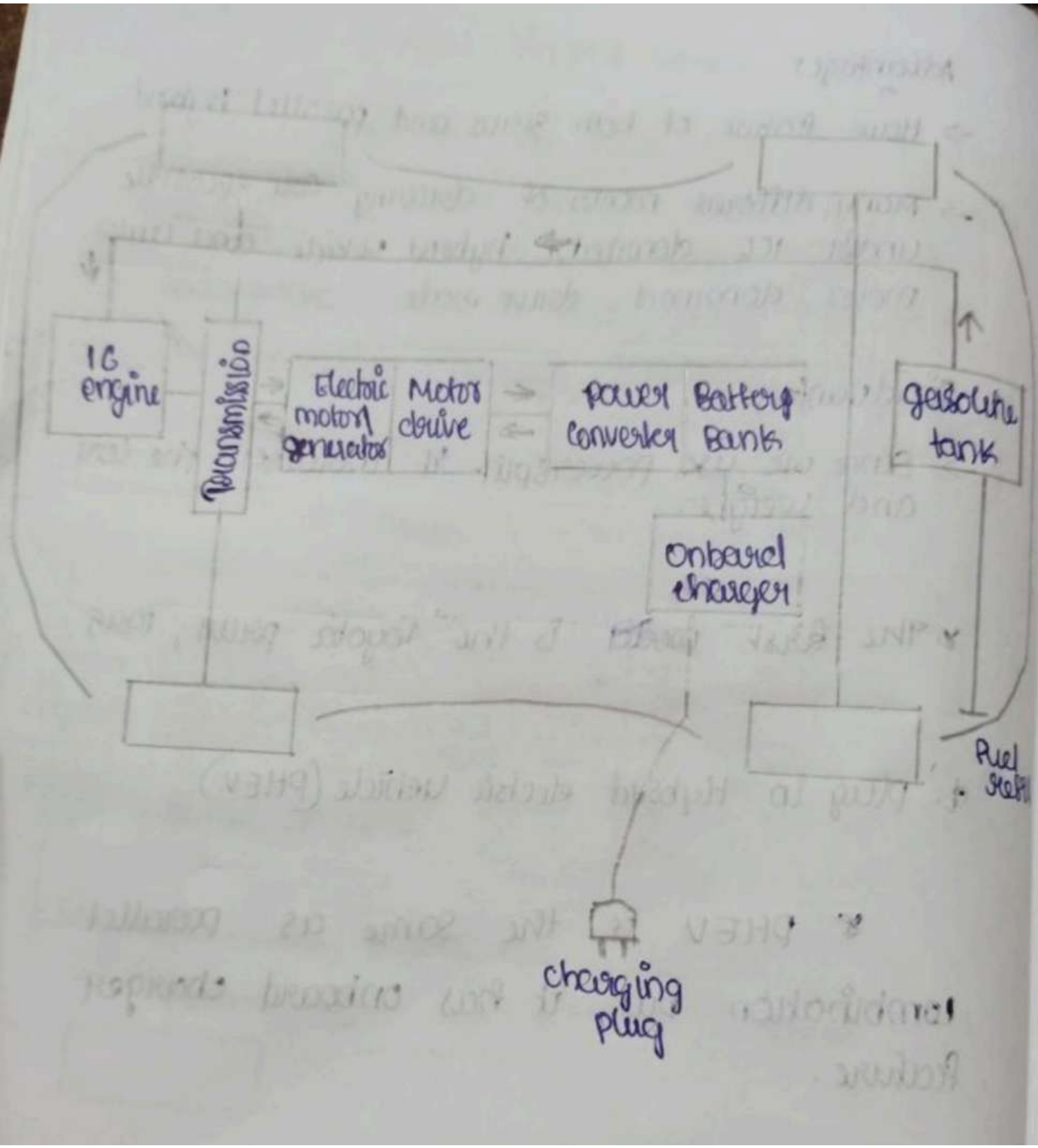
Disadvantage

-> Since we use powersplit it increases the cost and weight.

* The first model is the Toyota prius, 1995.

q. Plug in Hybrid electric vehicle (PHEV)

* PHEV is the same as parallel combination but it has onboard charger feature.


IC engine
Transmission
Electric motor generator
Motor drive
Power converter
Battery Bank
gasoline tank
onboard charger
charging plug

Advantages of PHEV

* Zero emission when daiving on batteries
* fuel efficiency in traffic

Disadvantages of PHEV

* Relatively expensive and complex to maintain
* Battery life concerns.

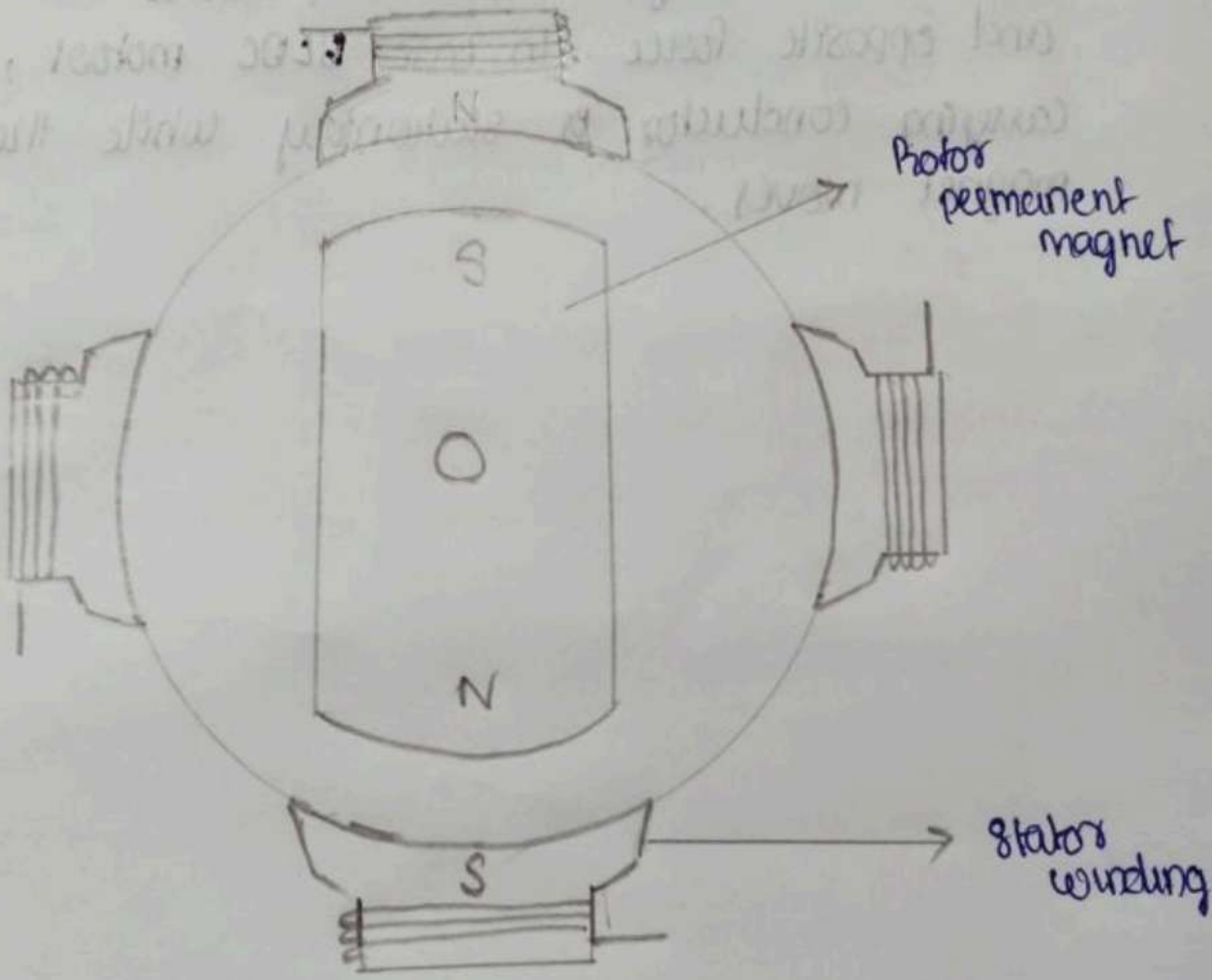
e. Fuel cell Electric vehicle (FCEV)

When comparing to others Fuel cell Electric vehicle uses hydrogen as fuel thereby it converted into electrical energy which stores in the battery pack to run the motor.

Disadvantages of HEVC

* Hydrogen storage and transportation
* Fuel cell efficiency.

Q3. Explain with diagram the construction and working principle of brushless Motor BLDC ?



working principle of BLDC motor

BLDC motor works on the principle similar to that of a conventional DC motor, the Lorentz force law which states that whenever a current carrying conductor placed in a magnetic field it experiences a force. As a consequence of reaction force, the magnet will experience an equal and opposite force. In case BLDC motor, the current carrying conductor is stationary while the permanent magnet moves.