

- ① Explain the journey of Automotive with the help of flow chart from the beginning of 18th century of the 21st century & give brief description on the following mile stone in the automotive.

Journey

- ① Invention of electric motor.

In 1820th 1st electric motor was invented. At Austria by Anos Zedli.

- ② Golden Era of EV

1837 to 1924 was the golden Era for electric vehicle. 1st

Successful electric vehicle was built in 1896 by William Morrison in US. It was designed as passenger carriage driven by driver with 2 passenger carrying capacity.

② Domination of Electric vehicle by gasoline cars.

In 1912, petrol powered car became easier to drive due to the invention. Electric car began to lose their position in the car market. At 1924 to 1960 EV was dominated by gasoline cars. At that time, the energy crises in 21st century led to renewed interest in electric cars. So a lot of small companies started to design and advertise electric cars to public.

④ Coming of New Era in EV

After the domination of gasoline car in 21st century, energy crises led to renewed interest in electric cars.

Then Toyota introduced RAV4-EVS. Tesla motors in 2004 started development

g Tesla Roadster model. They introduced lithium ion batteries. In 2022 many MNC companies had taken initiative for green mobility and EV vehicles.

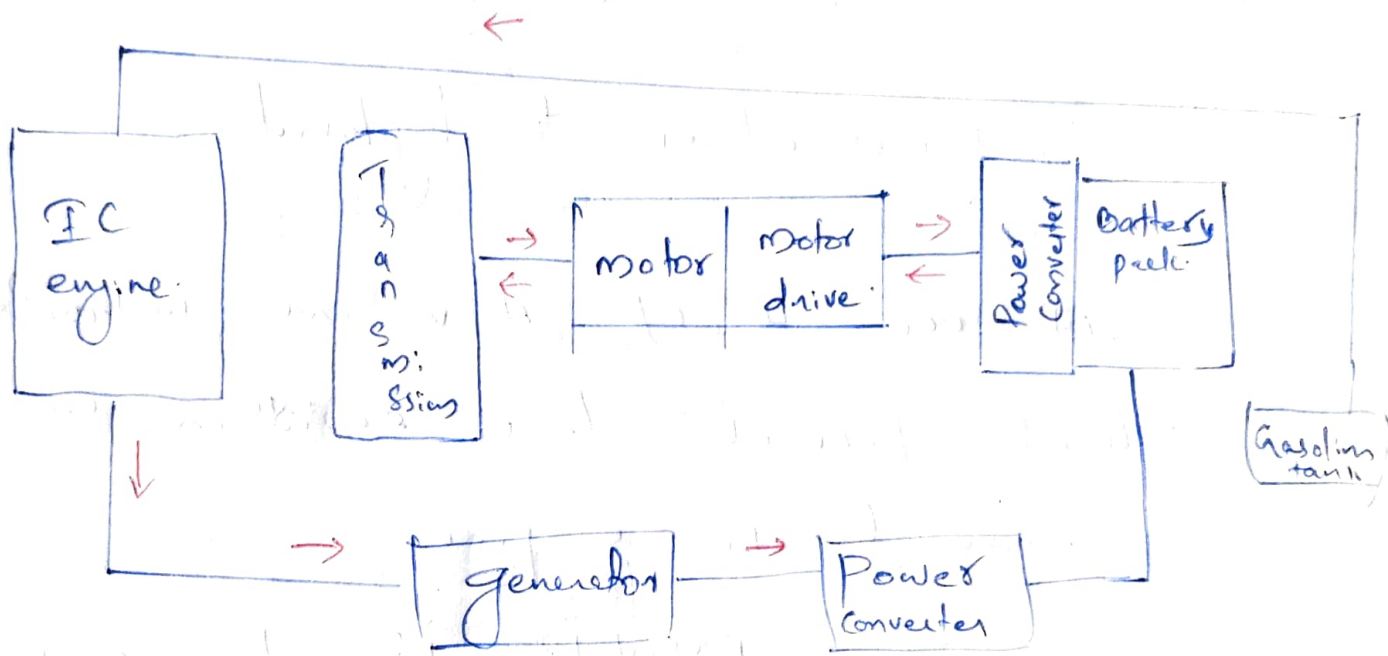
© Introduction to hybrid

At 2000 HSE/HSEV are introduced which provide less emission compared to normal IC engine.

eg :- BMW i8, i3, Prius etc.

Q2)

① Series hybrid electric vehicle



Working

Here gasoline is the primary source to produce electricity for battery. Fuel is used to work IC engine that generates electricity with the help of generator & convert the energy & stored in Battery pack that energy is used for transmission.

Advantage

eg:- ~~BMW~~ BMW i3.

- Mechanical decoupling between the ICE and drive wheels allows the IC engine operating at its very narrow optimal region.

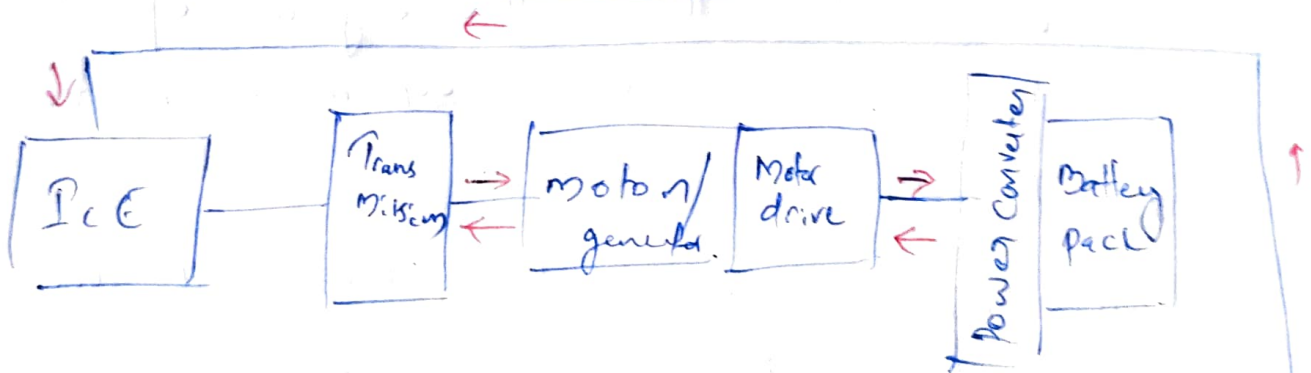
- Nearly ideal torque - speed characteristic of electric motor make multi gear transmission unnecessary

- Disadvantages

- ① Energy is converted twice & this reduces the efficiency.
- ② Two ^{electric} machines are used and a big reaction motor is required because it is the only torque source of the driven wheel

II

Parallel - Hybrid vehicle



Here the ICE has a direct connection with transmission. Also the regeneration / generation of electricity by motor is used to charge battery pack which is also used for electric motor transmission. Less complicated compared to Series-Hybrid

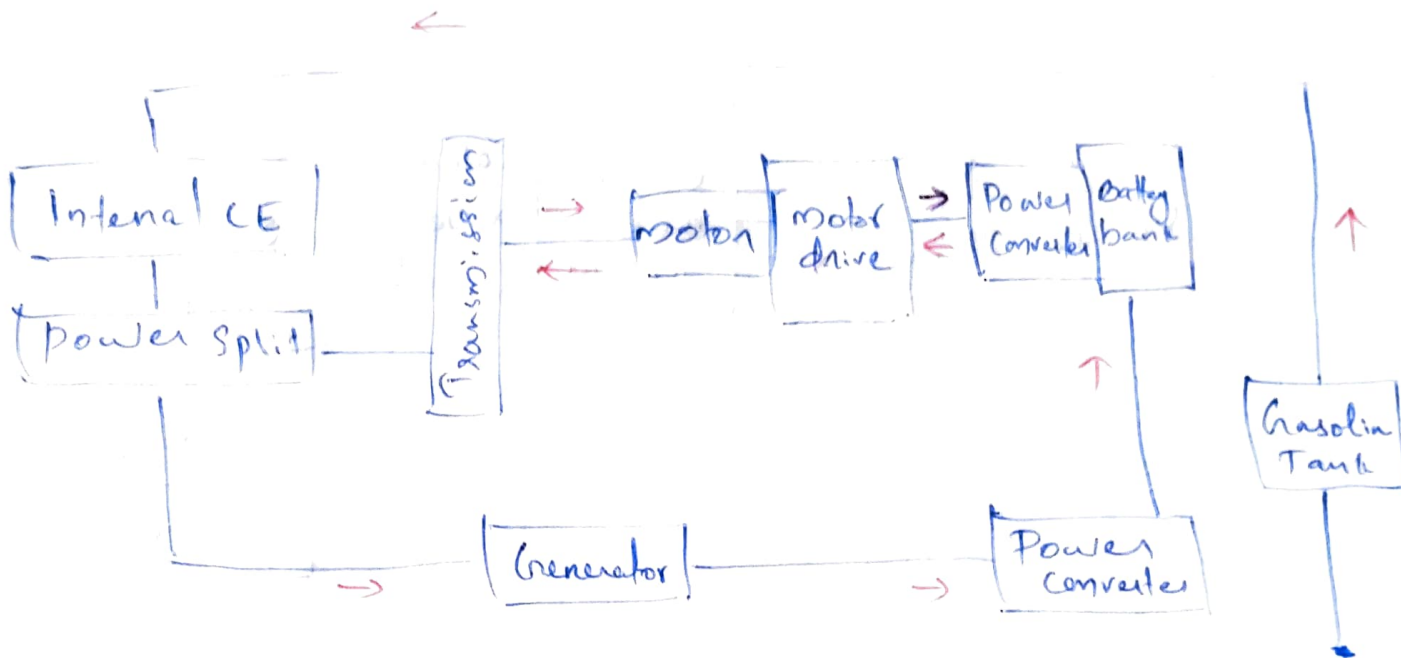
Advantage:

- ① Both engine & electric motor directly supply torques to the driven wheels and no energy form conversion occurs. Hence energy loss is less.
- ② Compactness due to no need of the generator and smaller traction motor.

Disadvantage

- ① Mechanical coupling b/w engine and the drive wheels, thus the engine operating points cannot be fixed in a narrow speed region.
- ② The mechanical configurations and the control strategy are complex compared to series hybrid drivetrain.

Series-Parallel Hybrid



Have features of both series & parallel hybrid.
Many different modes of driving are possible under ICE dominant hybrid vehicle and under motor dominant drive mode.
Here there is a power split connect to ICE & transmission.

- e.g. Toyota Prius

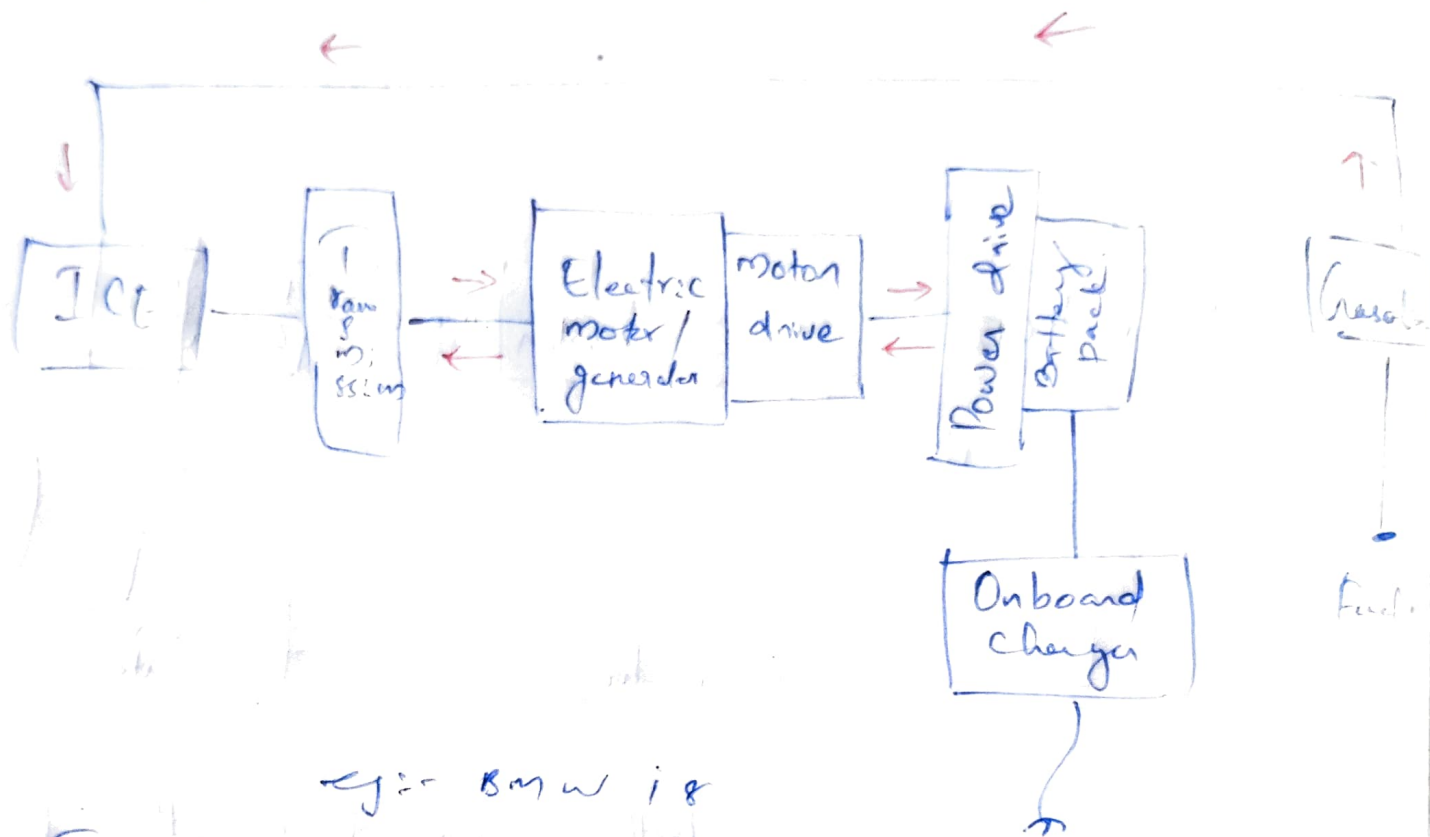
Advantage..

- good range

Disadvantage..

- Bulky or Heavy in size.

d) Plug in Hybrid EV



eg:- BMW i8

In plug-in Hybrid EV, we can charge battery bank by external electric source. Also there is a gasoline tank to drive the vehicle.

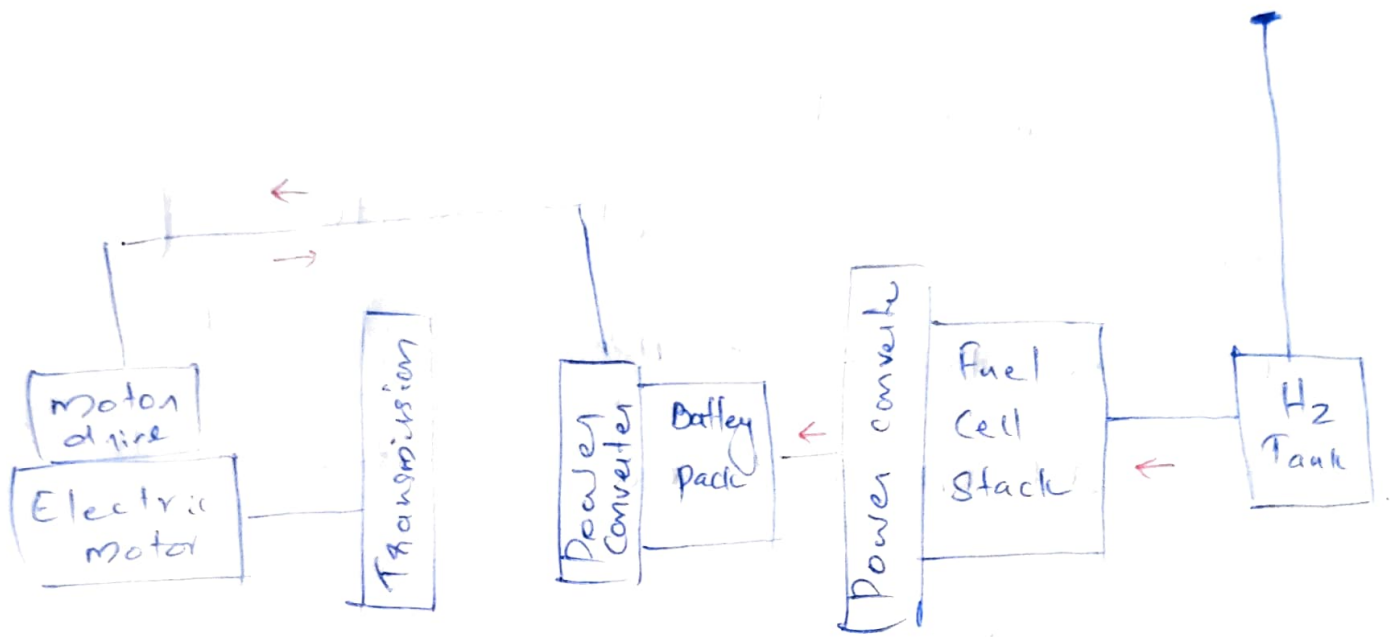
Advantage

- ① Zero emissions when driving on batteries
- ② Fuel efficient in traffic
- ③ Easy to drive.
- ④ Cheap to run if doing regular 10/15 miles.

Disadvantage

- Relatively expensive & complex to maintain
- Fuel economy not very good on motorway for
- battery life concerns.

(c) Fuel cell EV



in Fuel cell EV, uses fuel cell that generate electricity. Have to refilled at ~~0~~ Hydrogen charging station.

eg:- Nexa

Advantage

→ High range in efficiency.

Draw back

→ H₂ is highly complicated to store.

Q) Brushless DC motor

The motor has a 3 phase stator with 6 no. of coils & a rotor with surface mounted permanent magnet. The stator and permanent magnet are mounted on the stator.

Working

The poles on the stator are alternately in such a way that the rotor is turning clockwise. The pole on the stator pulls the pole on the ~~stator~~ rotor clockwise and when the poles are in line with each other the current is switched off. Momentum then carries the rotor further and the current is then reversed, changing the magnetic field and the pole is in stator.

BLDC motor are well efficient. The torque

is high under low speeds and goes down as the speed up.

Draw back

- price compared to other possible EV motor is high.
- it needs strong permanent magnets to that can influence the total price of the motor.

Diagram

