

Q.

Journey of Automotive.

- 1672 - Invention of the 1st steam-powered vehicle.
↓
1769 - Steam-powered automobile capable of human transportation.
↓
1826 - Samuel Brown tested first industrially applied IC engine.
↓
1826 → Thomas parker Invented first EV.
↓
1886 → Large Scale production of EV.
↓
1890 - Morrison Carriage (8 people carriage vehicle) was invented by William Morrison.
↓
1966 - Advanced EV
↓
1910 - EV started declining due to several reasons like → Invention of Assembly line production
→ world war, oil lobby.
1967 - California Air Resource Board Established (CARB)
1991 - LEV I (Low Emission Vehicle program) regulation by CARB to control pollution, requiring automobile manufacturers to introduce progressively cleaner light and medium duty vehicle with more durable emission controls from 1994 to 2003.
2003 - LEV 2 introduced to LEV - 10-15% less emission
ULEV - 70-80% less emission
PZEV - 0% emission
2006 - Tesla Roadster introduced.
2010 - first affordable EV, Nissan Leaf launched.

a) Invention of Electric Motor

The 1st commutator DC electric motor capable of turning machinery was invented by British scientist William Sturgeon in 1832.

b) Golden Era of EV.

Early 1900s was known as the golden era of EVs. During Golden age of EV, they made up more than $\frac{1}{3}$ rd of the car sales in US.

c) Domination of EV by Gasoline Cars.

Gasoline cars started dominating after the invention of Assembly line production of IC engine which helps to decrease the price of engine in terms reduce in the overall price of the gasoline vehicles. And the self starting mechanism of IC engine (1912) also boosted this.

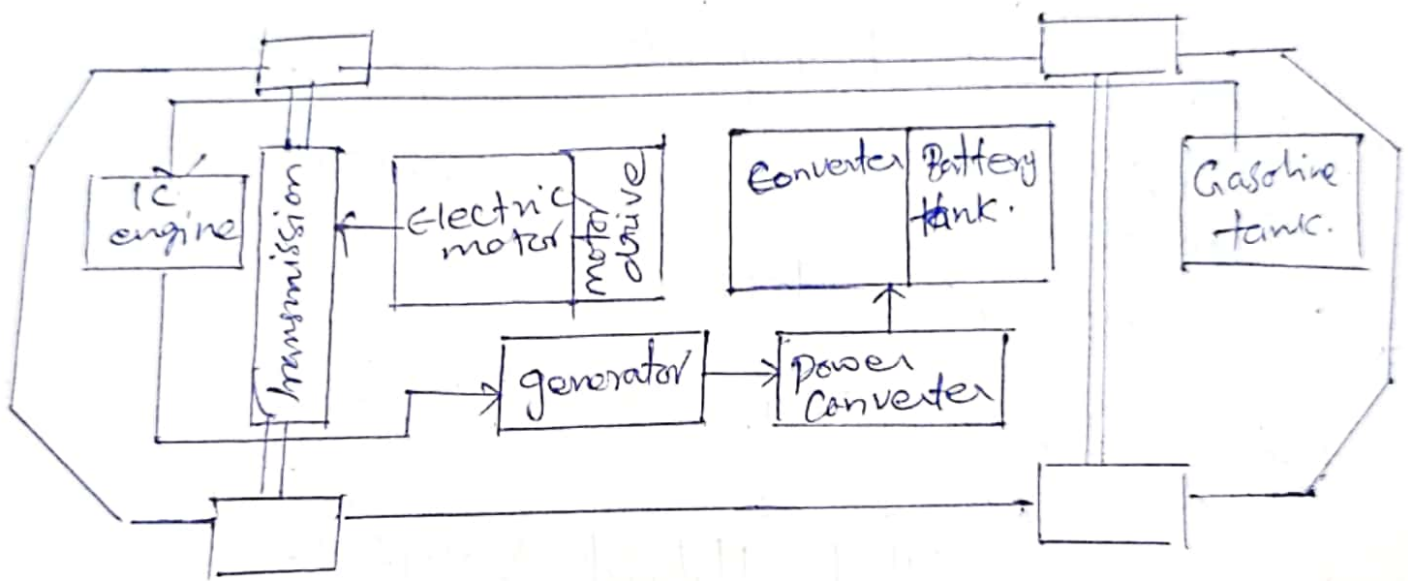
d) Coming of New Era in EV.

New era of EV was started with C.A.R.B. C.A.R.B. adopted LEV 1 & LEV 2 programs which enhanced the EV production.

e) Introduction of hybrid vehicles.

Introduction of hybrid vehicles started a new era in the vehicle market. These are more efficient than other vehicles.

Q.9) Series hybrid vehicle.



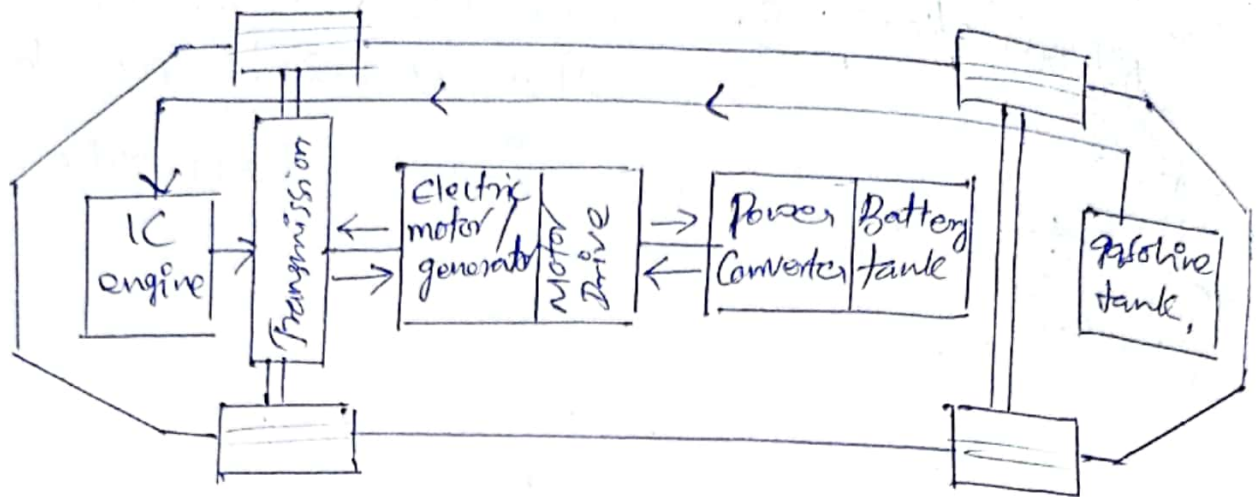
Advantages

- Smaller and efficient engine
- reduced harmful gas emission.

Disadvantages.

- require 3 machines with similar power ratings.
- no. of energy conversion results in loss.

1) Parallel hybrid vehicle.



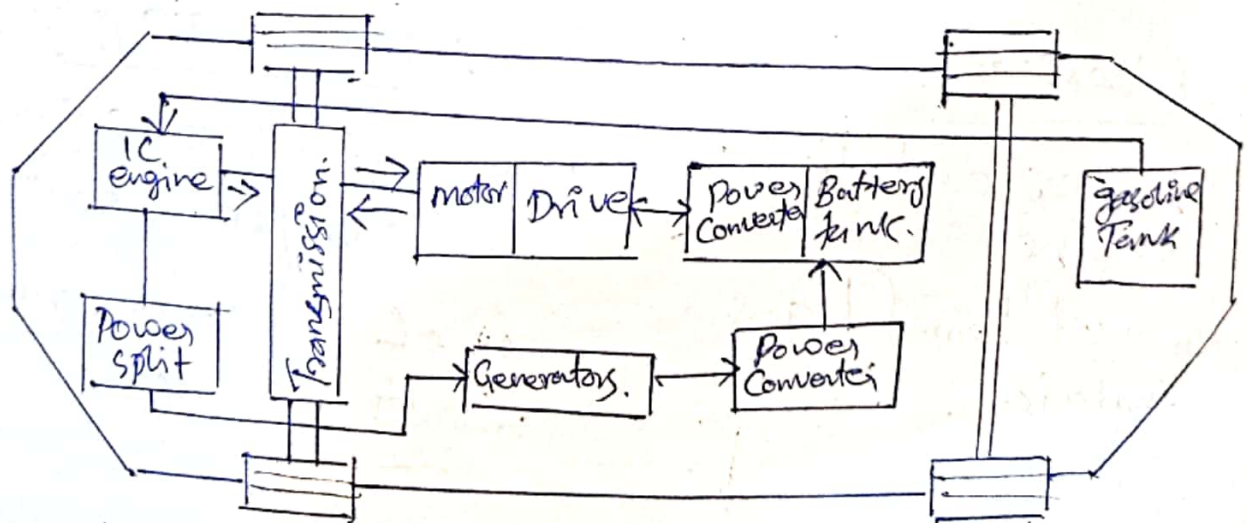
Advantages

- use smaller battery pack
- relying on regenerative braking
- engine noise less
- eg: Honda Civic

Disadvantages

- high cost
- high weight,

2) Series-parallel Hybrid Vehicle.



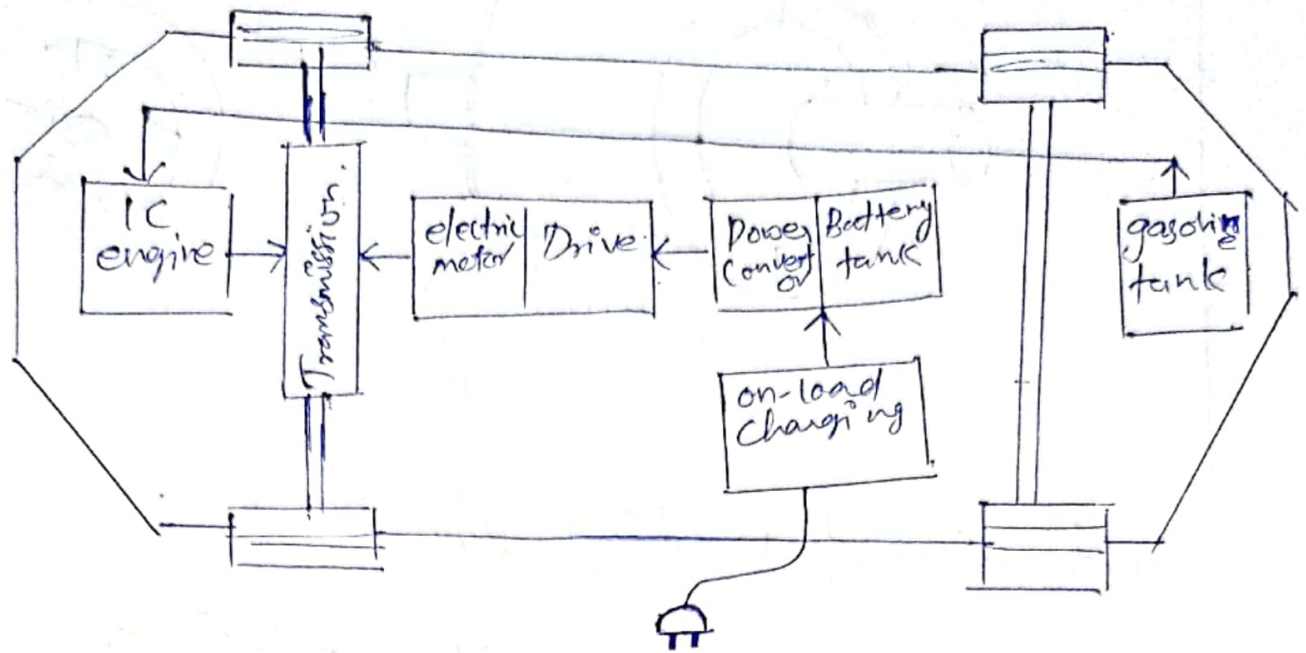
advantages

- high efficiency.

Disadvantages

- larger battery, motor & generator.
- high cost.

d) plug in hybrid electric vehicle.



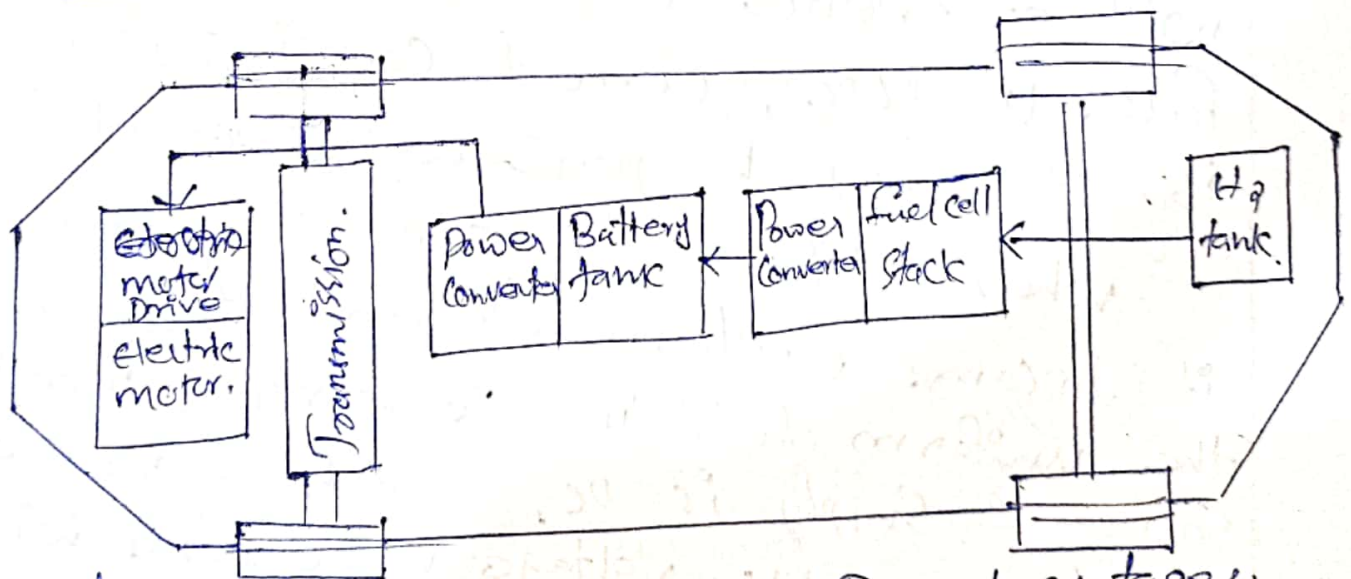
Advantages -

- less greenhouse gas emission.
- lower fuel cost.

Disadvantages -

- Recharging taking time.
- Higher vehicle cost.

e) Fuel cell Electric Vehicle.



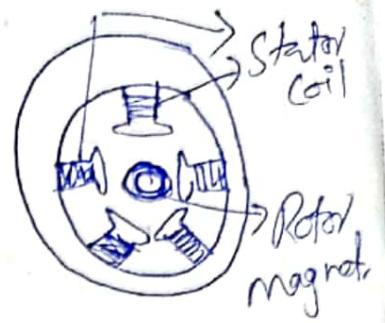
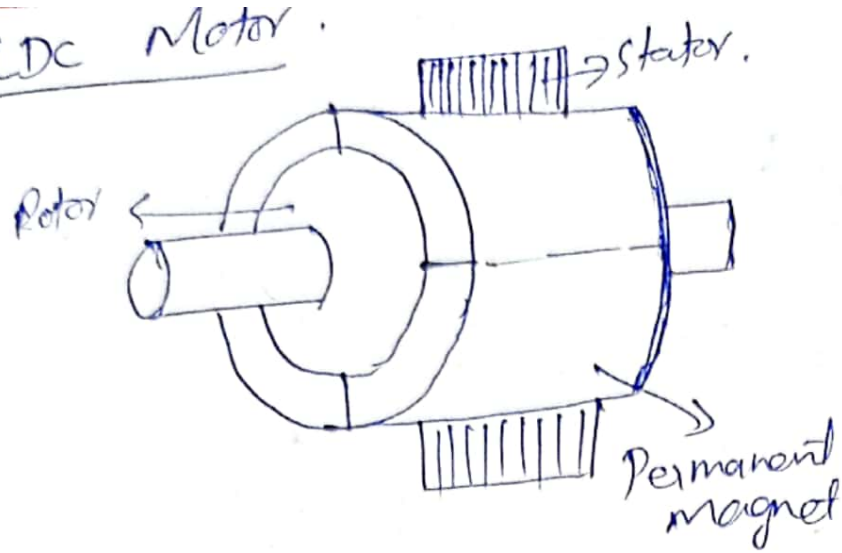
Advantages -

- no harmful tailpipe emission.
- Renewable & Readily available fuel

Disadvantages -

- Storage and transportation of hydrogen.
- Fuel cell efficiency.

Q3. BLDC Motor



Construction & Working Principle

BLDC motor works on the principle similar to that of a Brushed DC motor. The Lorentz law, which states that whenever a current carrying conductor placed in a magnetic field experiences a force. As a consequence of reaction force, the magnet will experience an equal and opposite force. In BLDC, current carrying conductor is stationary & permanent magnet is moving when stator coils get supply from source, it becomes electromagnet and starts producing the uniform field in the airgap. Though the source of supply is DC, switching makes to generate an AC voltage wave form with trapezoidal shape. Due to the force of interaction between electromagnet stator and permanent magnet rotor, rotor continues to rotate.