

1.
a. Invention of Electric motor.

In 1828, the Hungarian inventor
Anjos Tedlik invented a world's first Electric
motor, and created a first small model car
Powered by his Electric motor.

b. Golden Era of EVs.

In 1900-1910 was known as the
Golden era of EV. Because the 32% of car
in the market was Electric on that time.
The main reason for the ~~popul~~ popularity of
EV in that time was :-

- NO emission
- Efficient
- Low cost
- Easy start
- good range of (100 miles).

c. Domination of Electric vehicle by gasoline cars

- Henry Ford introduced IC engine Assembly
line production.
- Henry Ford reduce IC engine price
30% year by year.
- In 1912 self start mechanism was
introduced by chevrolet.

- World war II also domination the EV, the range and charging time was not affordable for ~~world war~~ the vehicle used in everyday.

This are the major reasons for the domination of EV by gasoline cars.

Coming of New Era in EV.

- After 1950s there is several environmental issues happened on London and ~~12000~~ 12000 people was died in 4 days. the incident called (The Great smog).
- Also After 1960s the same issues was happened at US, 600 new cases was happened in every day related to pollution. After the ~~research~~ research about it people know that 48% of ~~smog~~ pollution was from automobiles.
- In 1970 the emission regulation was published by (CARB). every 10 years they introduced new regulation.
- ~~2003~~ In 2003 ~~EPA~~ CARB introduced there main regulation called LEV II
 - LEV (Low emission vehicle) → 10-15% ↓
 - ULEV (Ultra low emission vehicle) → 70-80% ↓
 - PZEV (Pure zero emission vehicle) → 0% emission.
- In 2008 Tesla Roadster was came into market and it change the car industry.

* 2010 Nissan Leaf was introduced as it is the first affordable family car.

This too car prove that EV can own by every one and it is better to comparatively gasoline cars, and also introduce a new era of EV

c.

Introduction to Hybrid Electric vehicles.

Hybrid vehicle is a type of vehicle that combines a converted IC engine and electric motor. The presence of the electric powertrain is intended to achieve better fuel economy, better performance and low emission than a conventional IC engine. There are types of hybrid vehicles they are :-

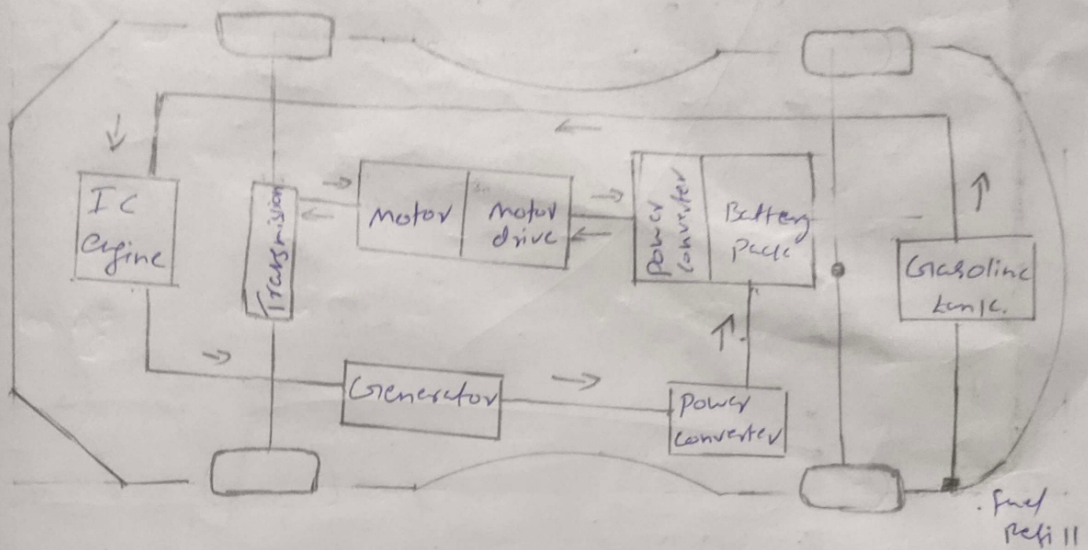
- Parallel hybrid
- Series hybrid
- Series parallel hybrid
- Plug in hybrid

2. a.

Series Hybrid

Vehicle fitted with IC engine and motor. But in this case the IC engine is used to generate power to recharge the battery pack to drive the electric motor.

Series Hybrid



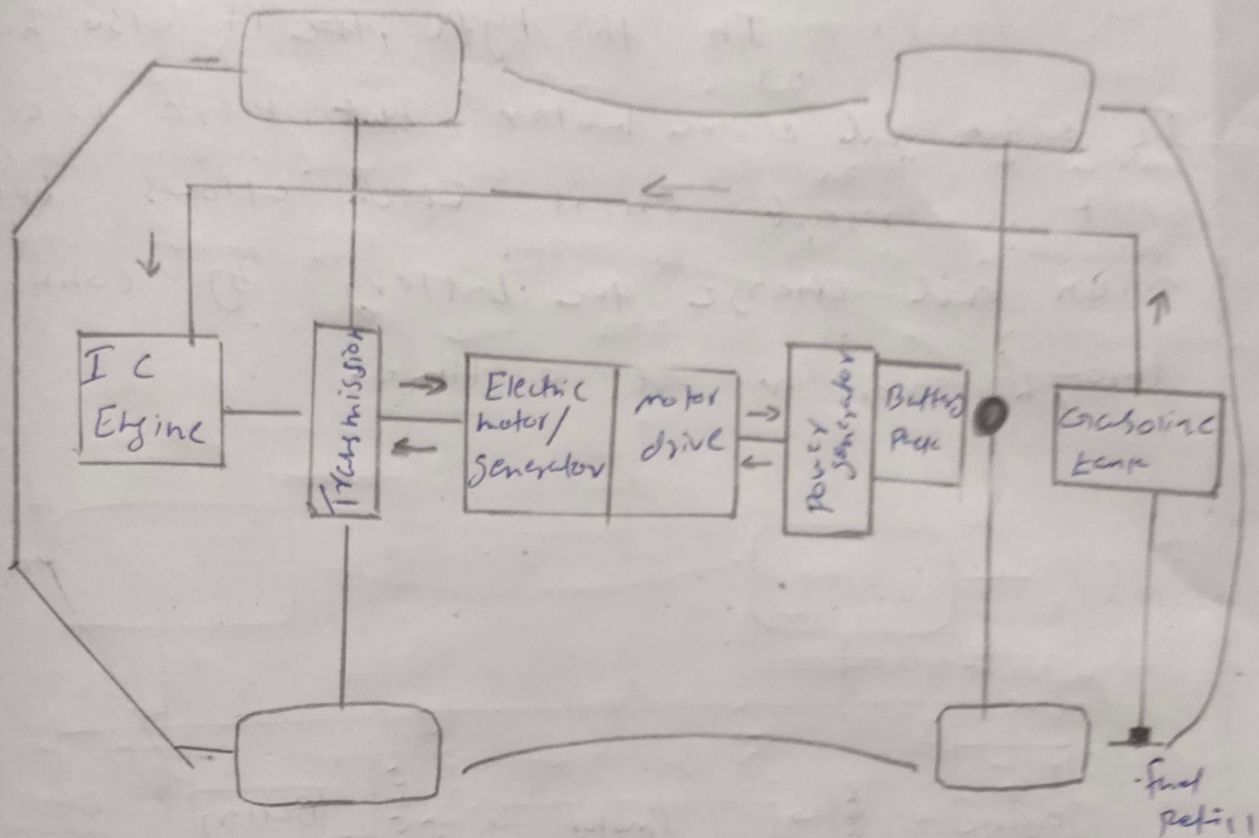
Advantages

- Mechanical decoupling b/w the ICE and driven allows the IC engine operating at its very narrow optimal region.
- Nearly ideal torque-speed characteristics of electric motor make multi-gear transmission unnecessary.

Disadvantages

- The energy is converted twice (mechanical to electrical and then to mechanical) 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 wheel.

b. parallel hybrid



A parallel hybrid is propelled by both IC and electric motor. ~~the vehicle is~~ In this type the power distribution b/w the engine and the motor is varied, so both run in optimum operating region as much as possible. There is no separate generator in a parallel hybrid. The battery was charged by regeneration.

Advantages (Parallel)

- 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 the generator and smaller traction motor.

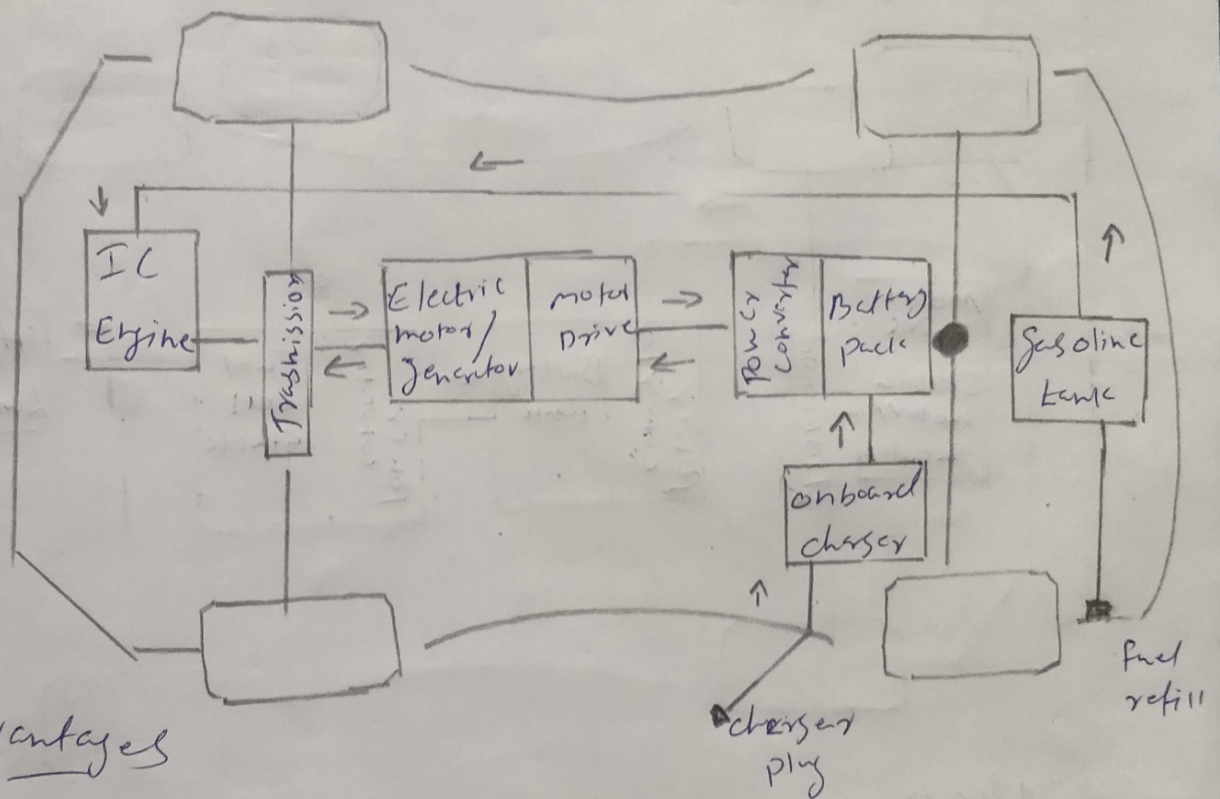
Disadvantages

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

C. series and parallel hybrid

Plug in Hybrid (PHEV)

PHEV is the same as the Parallel combination, but the ^{charging} ~~charging~~ it has onboard charger feature.



Advantages

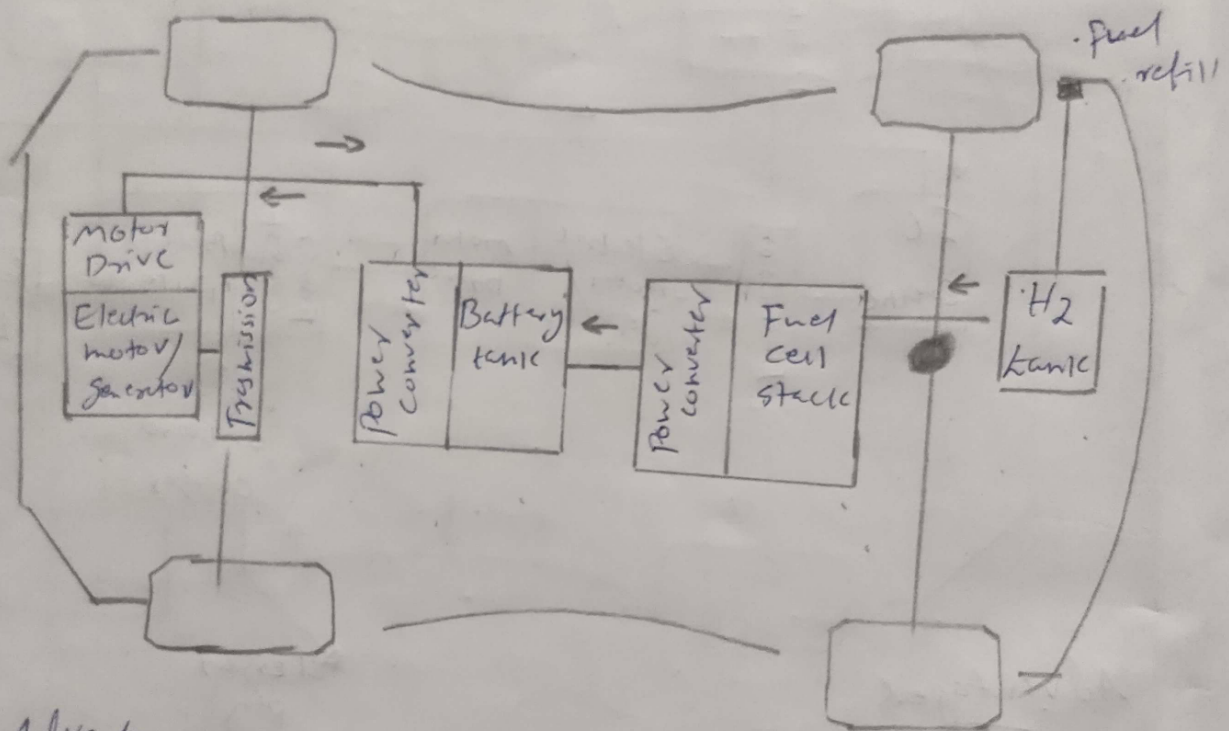
- Zero emission when driving on batteries
- fuel efficiency

Disadvantages.

- Relatively expensive and complex
- Battery life concerns.

e. Fuel cell Electric vehicle (FCEV)

When compared to others fuel cell have hydrogen as used as fuel. It convert the hydrogen into electrical energy and stores the battery pack to run the motor.



Advantages

- High energy density improves productivity.
- Reduce CO₂

Disadvantages

- Storage and transporting of hydrogen have more ~~is dangerous~~ ^{careful}
- Fuel cell efficiency.

3. Explain with diagram the construction and working principle of brushless motor BLDC.

working principle

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 BLDC rotor is permanent magnet and stator is the ~~winding~~ winding.

