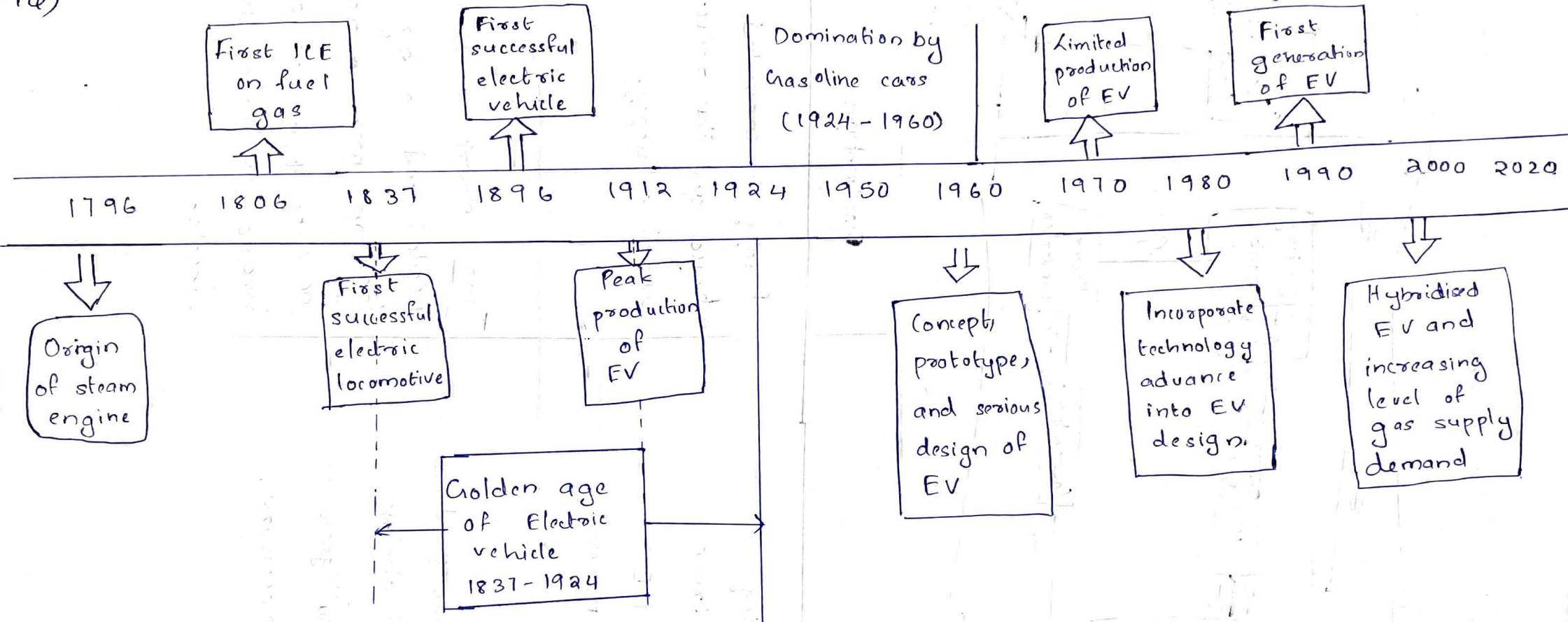
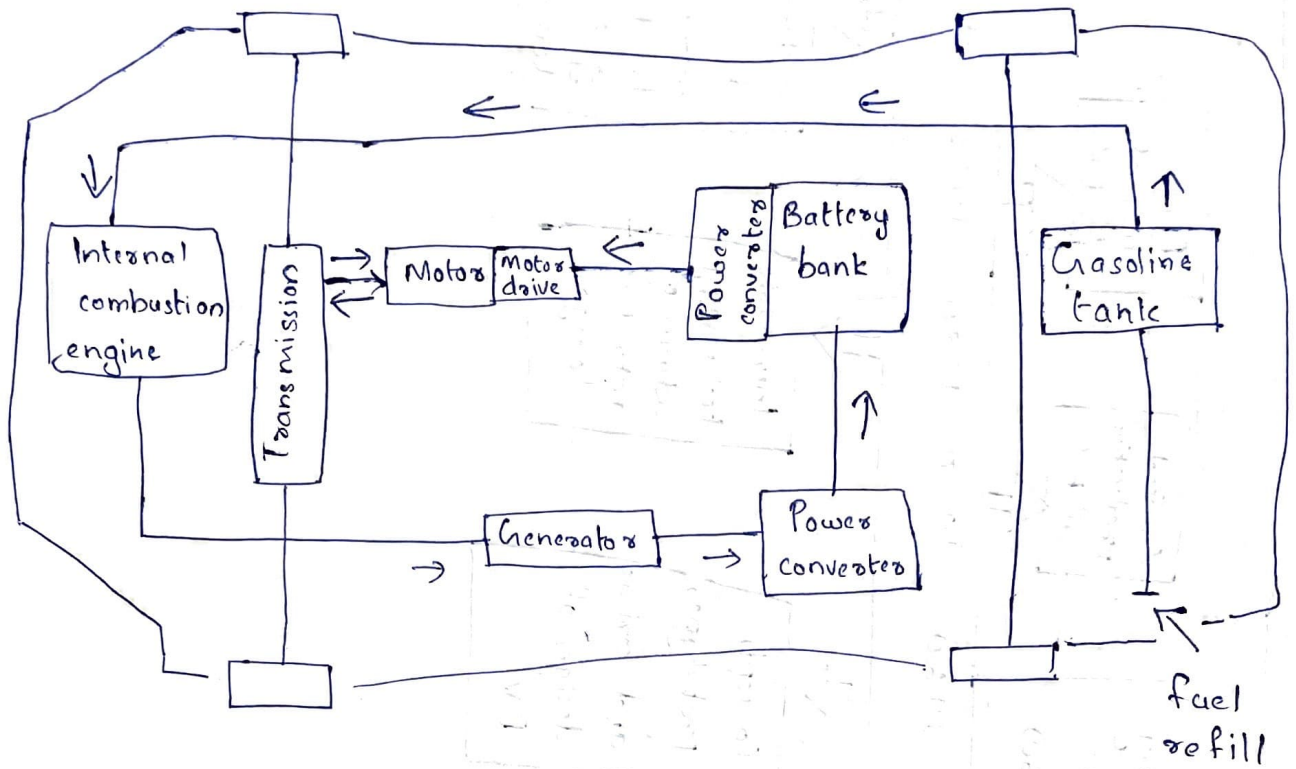


10)



## (a) Series hybrid Electric Vehicle



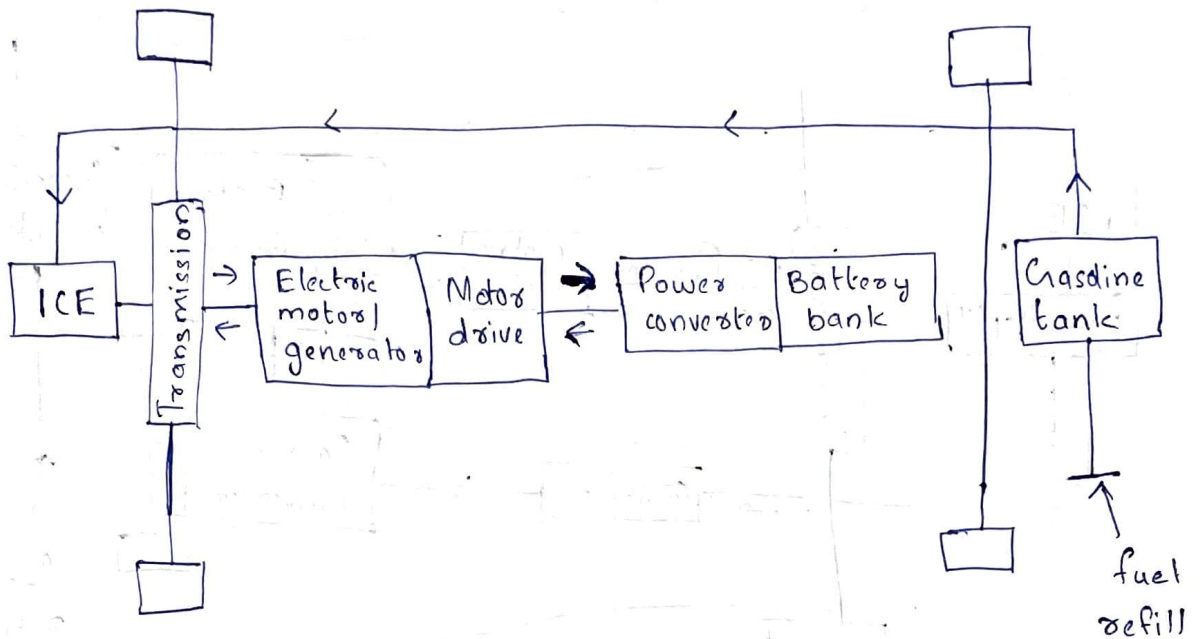
### Advantages

- Mechanical decoupling between ICE and driven wheels allows ICE operating at its narrow optimal region
- Nearly ideal torque speed characteristics of electric motor make multigear transmission unnecessary.

### Disadvantages

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

## (b) Parallel hybrid



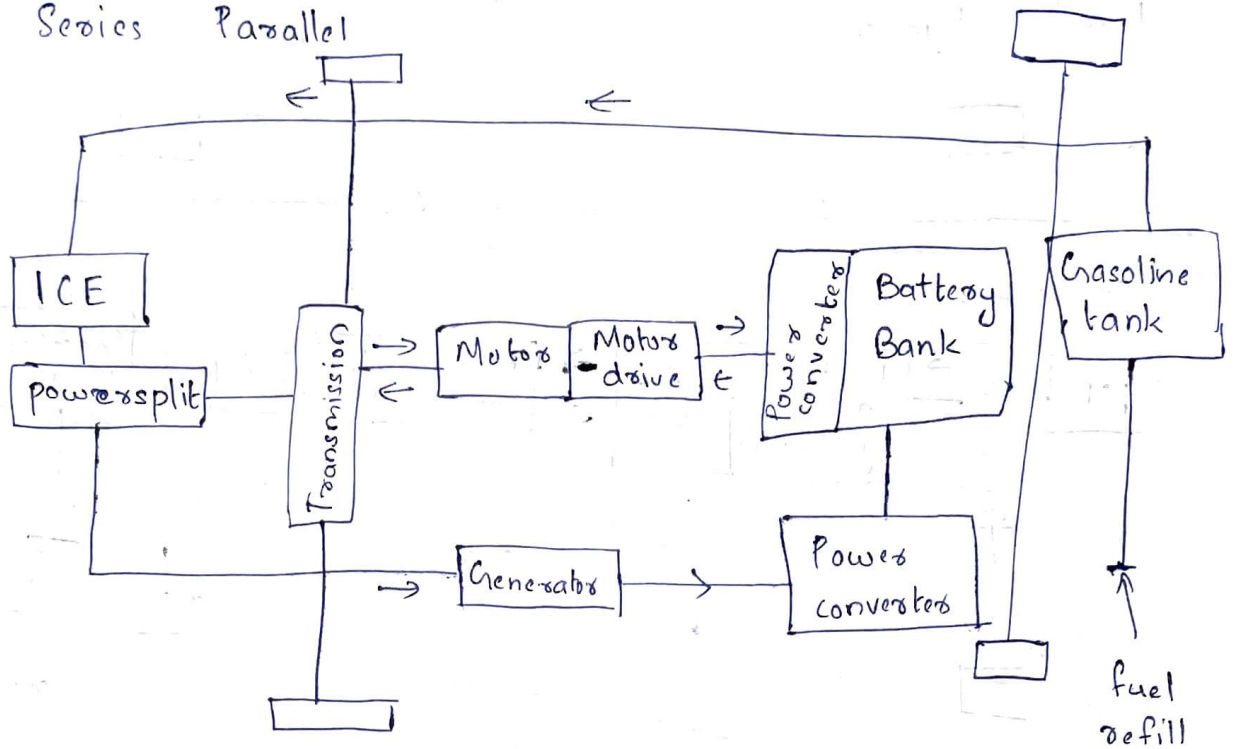
### Advantages

- Both directly supplies torque to the driven wheels.
- Compactness due to no need of the generator and traction motor.

### Disadvantages

- Engine operating points cannot be fixed in a narrow speed region.
- The mechanical configuration and the control strategy are complex compared to series hybrid drive train.

(c) Series Parallel



### Advantages

### Disadvantages

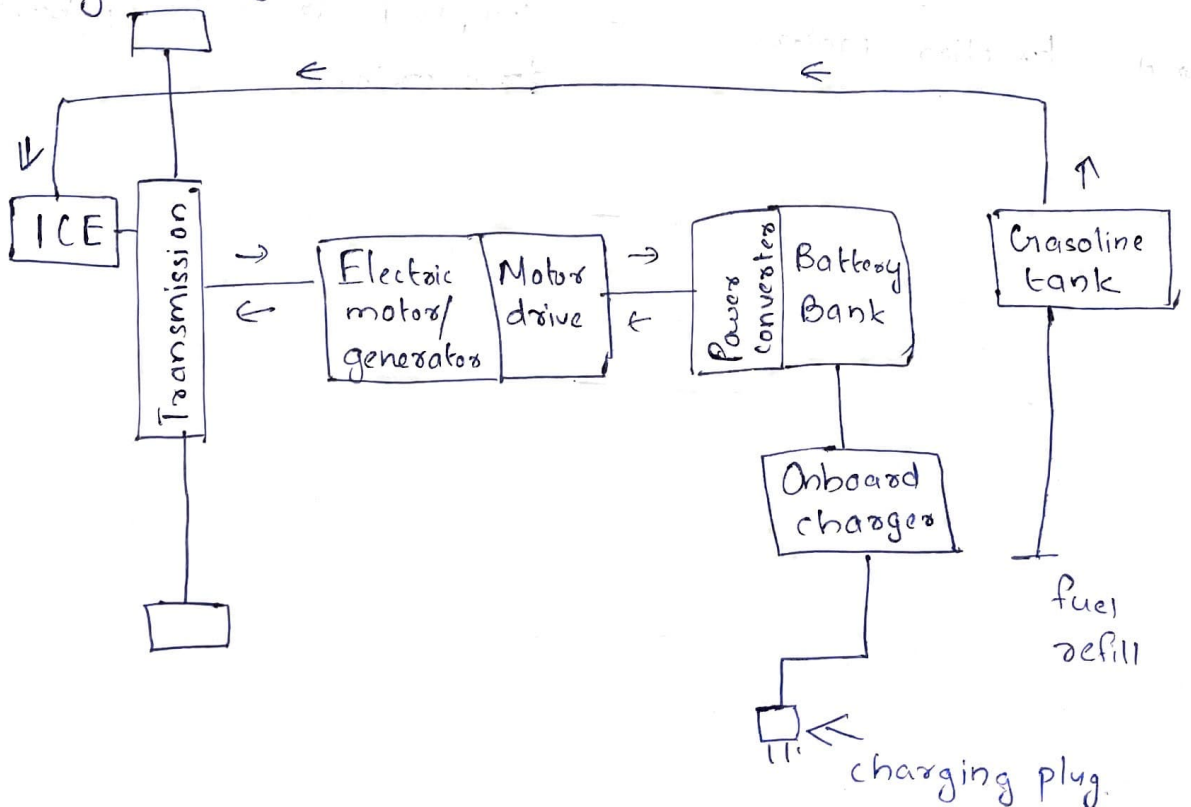
Combines the advantages of Series and parallel drivetrain

- Addition of powersplit device makes drivetrain more complicated.

- ICE works in ideal range

- Maintenance of powersplit

(d) Plug in hybrid EV



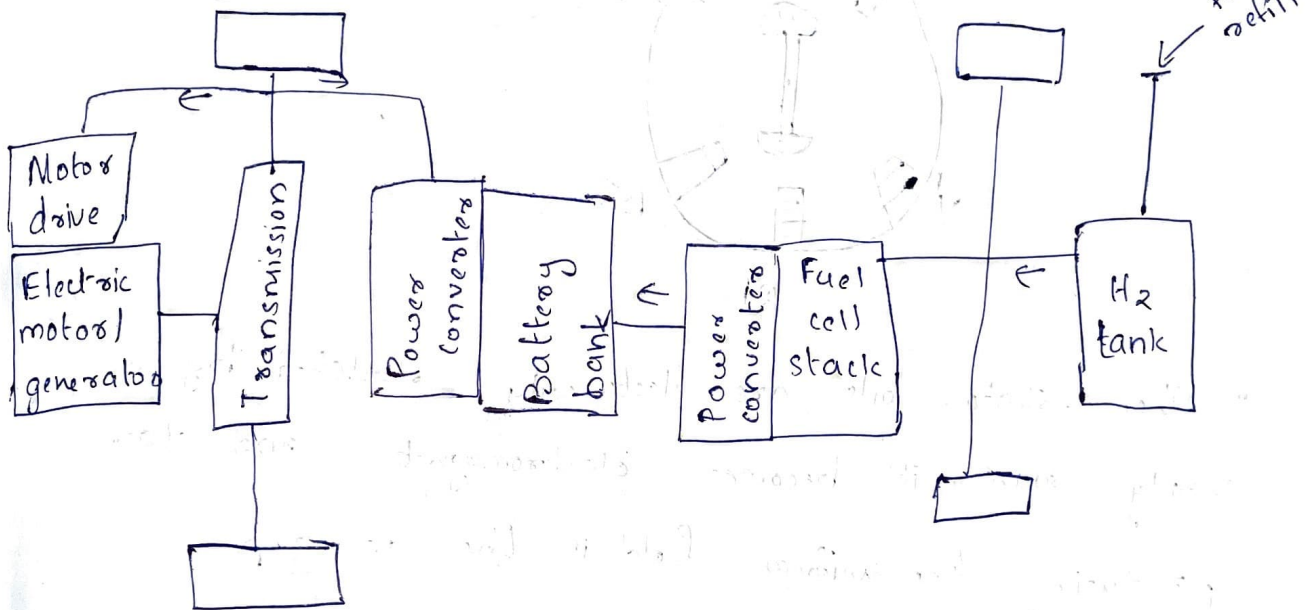
## Advantages

- zero emission when driving on batteries
- fuel efficient in traffic
- easy to drive

## Disadvantages

- relatively expensive & complex to maintain
- fuel economy not good on long journeys
- battery life concerns.

### (e) Fuel Cell EV



## Advantages

- Does not produce CO<sub>2</sub> emissions
- Refueling takes only few minutes and H<sub>2</sub> fuel cell
- Lithium ion has energy density similar, making them great.

## Disadvantages

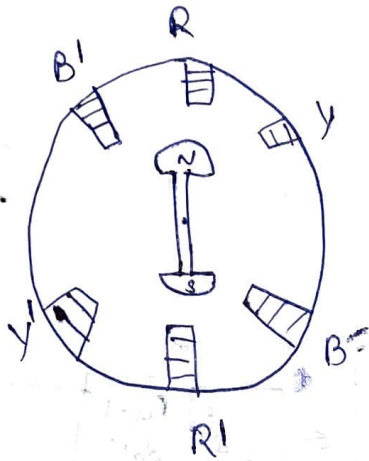
- Hydrogen production by ~~through~~ reforming method causes CO<sub>2</sub> emissions.
- Transportation is difficult
- Safety concerns

Q3)

### BLDC motor

- It works with a similar principle of DC motor.

In case of BLDC motor current carrying conductor is stationary while permanent magnet moves.



- When stator coils are electrically switched by a supply source, it becomes electromagnet and starts producing the uniform field in the air gap.
- Though the source of supply is DC, switching makes to generate an AC voltage waveform with trapezoidal shape.
- Due to force of attraction between electromagnet stator and permanent magnet rotor the rotor continues to rotate.
- Hall sensors give shaft position as feedback to electronic controller.

# switching sequence

