Assignment 1

Q1. Explain the Journey of Automotive with the help of flow chart from the Beginning of 18th Century to The 21st Century & give brief description on the following milestones in the Automotive Journey:-

a) Invention of Electric Motor

b) Golden Era of EV

c) Domination of Electric Vehicle by Gasoline cars

d) Coming of New Era in EV

e) Introduction to Hybrid Electric vehicles

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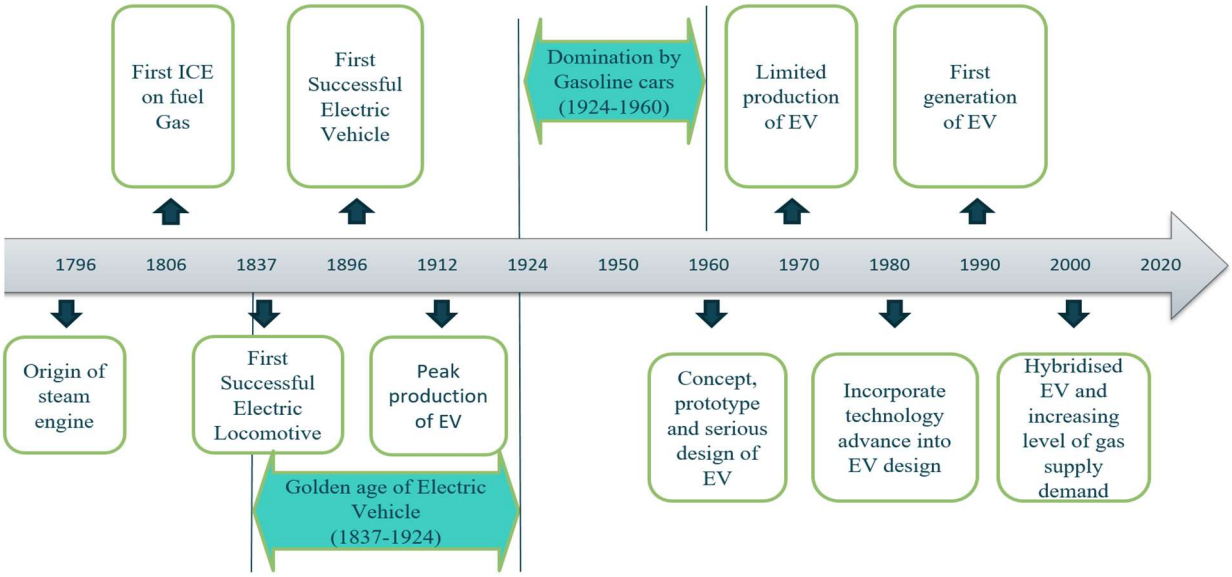

- In 1828, the Hungarian inventor Anyos Jedlik invented an World's First Electric Motor , and created a First small model car powered by his Electric Motor.
- Scottish inventor Robert Anderson also invented a crude electric carriage between 1832 and 1839.
- The first known electric locomotive was built in 1837, in Scotland by chemist Robert Davidson of Aberdeen.
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- In 1912, petrol-powered cars became easier to drive due to the invention of Charles Kettering and his electric “starter”,

- 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.

Q2. Explain and Draw the Layout of following Hybrid Electric vehicles with their two Advantages, Disadvantages & Industrial application in automotive segment?

a) Series Hybrid Electric vehicles

b) Parallel Hybrid Electric vehicles

c) Series Parallel Hybrid vehicle

d) Plug in Hybrid electric vehicle

e) Fuel Cell Electric Vehicle

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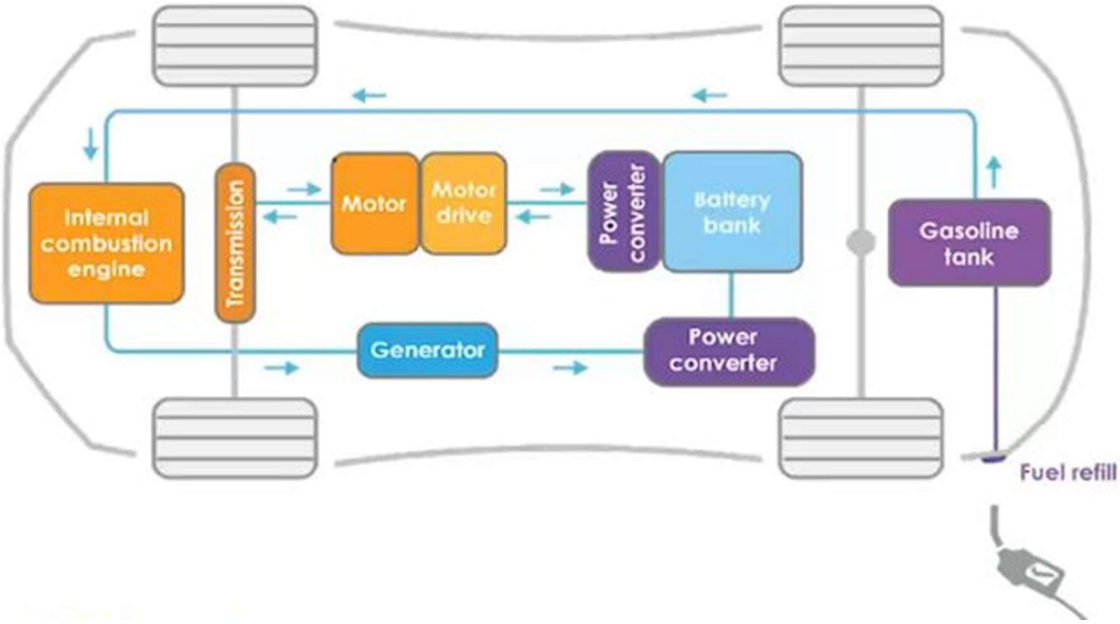
a) Series Hybrid Electric vehicles



Case 1 : Normal Driving

- IC Engine - Running
- Motor- Running

Case 2: Light Load

- IC Engine- Off
- Motor- Running

Case 3: During Braking

- IC Engine - Off
- Motor – Acts as a generator

Case 4: Vehicle at stop

- IC Engine- Off
- Motor- Off

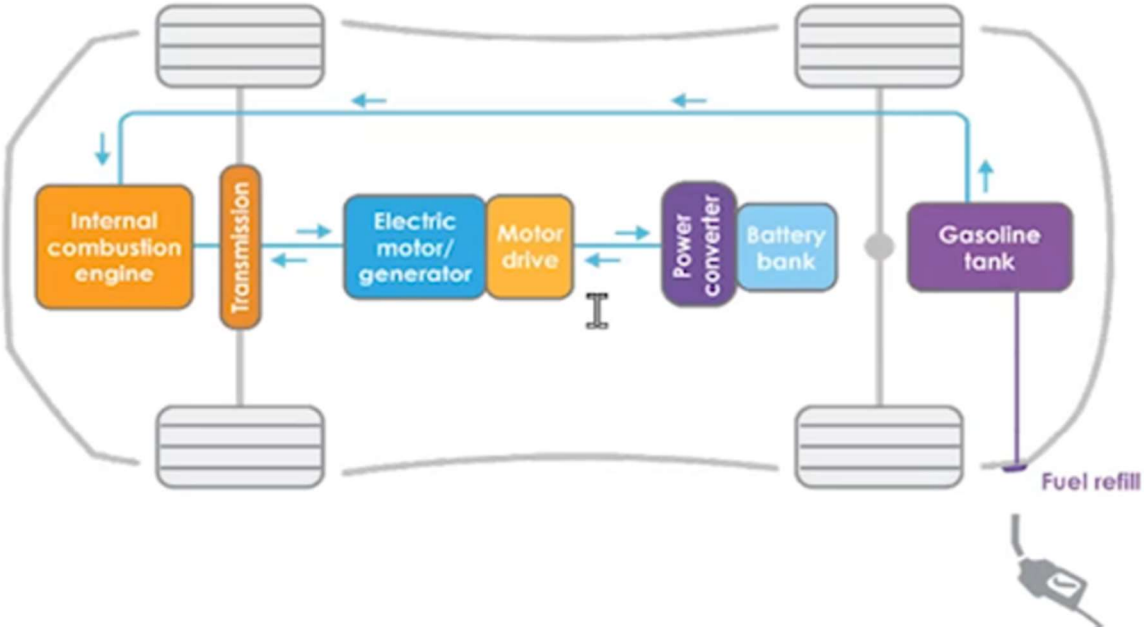
Advantages of the Series Hybrid Vehicle.

- Mechanical decoupling between the ICE and driven wheels 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 of the Series Hybrid Vehicle.

- 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 wheels.

b) Parallel Hybrid Electric vehicles



Case 1 IC Engine

- Motor – Charging
- IC Engine – Performing Drive

Case 2: Electric Drive

- Motor - Performing Drive
- IC Engine- Rest Condition

Case 3: Hybrid Mode

- Engine
- IC Engine

Case 3: Low Battery

- Engine – Charging & drive mode

Case 5: Regenerative Braking

- Motor- Generator, Power stored in battery.

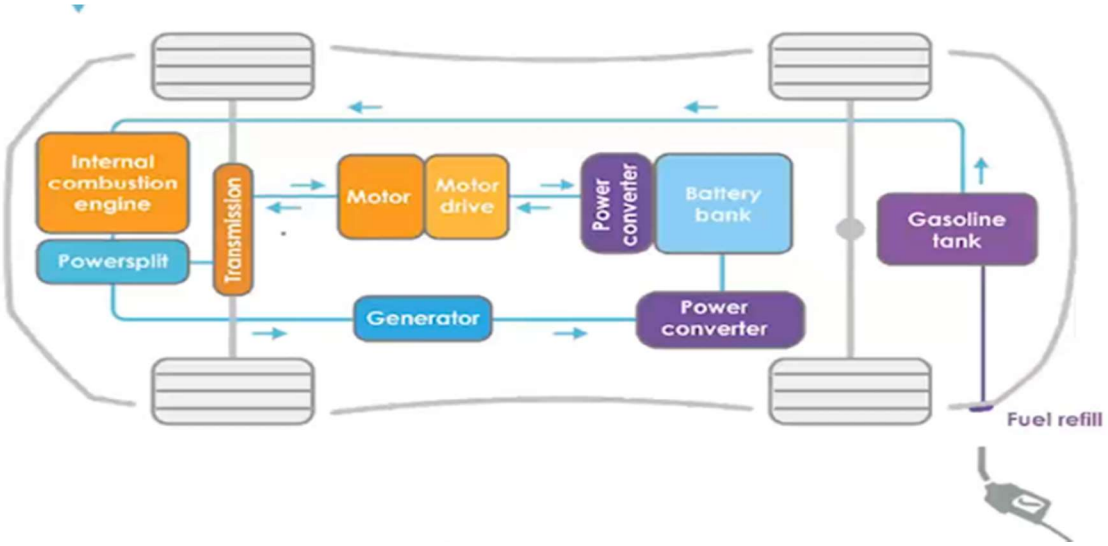
Advantages of the Parallel Hybrid Vehicle.

- 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 of the Parallel Hybrid Vehicle.

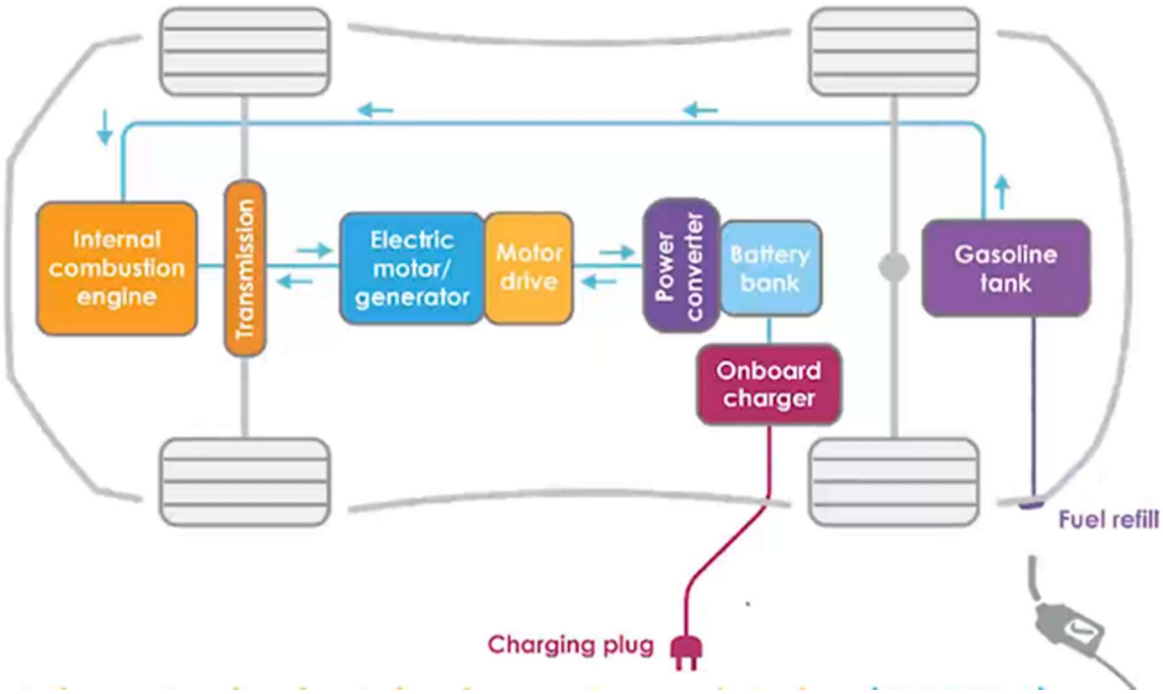
- Mechanical coupling between the engines and the driven wheels, thus the engine operating points cannot be fixed in a narrow speed region.
- The mechanical configuration and the control strategy are complex compared to series hybrid drivetrain.

c) Series Parallel Hybrid vehicle



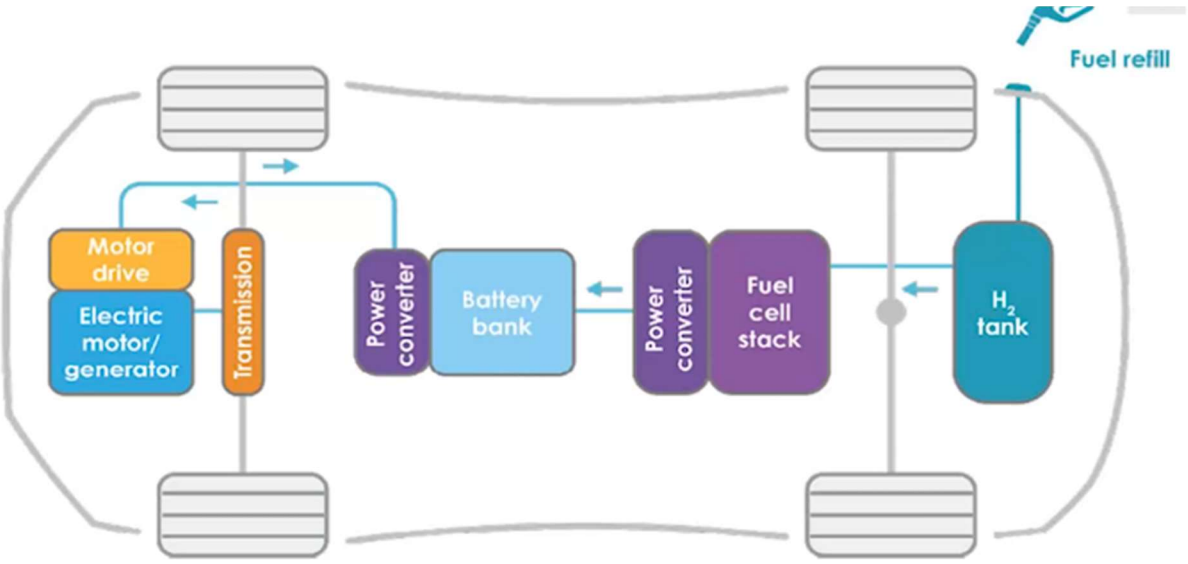
- Have feature of both series and parallel hybrid.
- Many different modes of driving are possible under ICE dominant hybrid vehicle and under Motor dominant drive mode.
- First model- Toyota Prius, 1995.

d) Plug in Hybrid electric vehicle



- **Advantages of the Plug in Hybrid electric vehicle (PHEV)**
    - zero emission when driving on batteries
    - fuel efficient in traffic
    - easy to drive
    - cheap to run if doing regular 10/15 mile commutes .
- **Disadvantages of the Plug in Hybrid electric vehicle (PHEV)**
    - relatively expensive & complex to maintain
    - fuel economy not very good on motorway journeys
    - battery life concerns

e) Fuel Cell Electric Vehicle



- In fuel cell electrical vehicle H2 is use as a fuel.
- H2 is separated as H+ and H-
- H+ is composited with oxygen H2O as water.
- H- is given to the fuel cell and charge will be generate
- Remaining working as Series electrical vehicle.

Q3. Explain with Diagram the Construction & Working principle of Brushless Motor BLDC?

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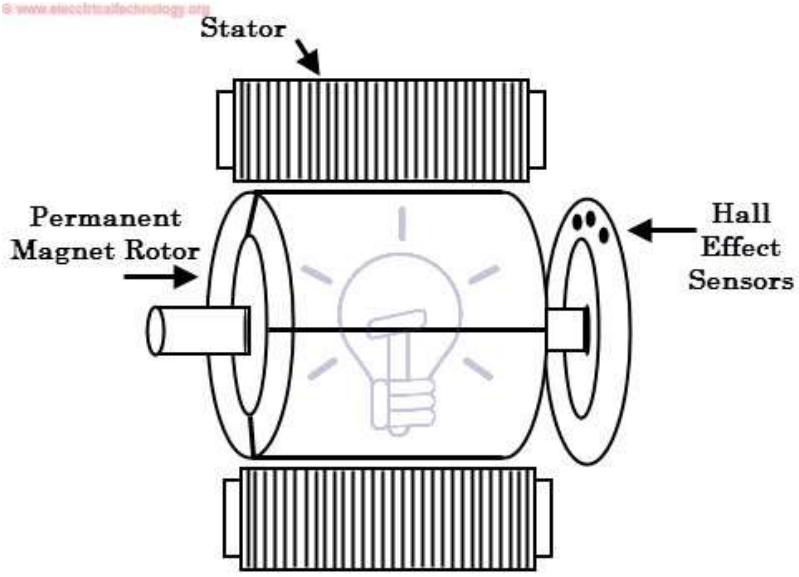
BLDC motors can be constructed in different physical configurations. Depending on the stator windings, these can be configured as single-phase, two-phase, or three-phase motors. However, three-phase BLDC motors with permanent magnet rotor are most commonly used. The construction of this motor has many similarities of three phase induction motor as well as conventional DC motor. This motor has stator and rotor parts as like all other motors.



Stator of a BLDC motor made up of stacked steel laminations to carry the windings. These windings are placed in slots which are axially cut along the inner periphery of the stator. These windings can be arranged in either Star or Delta. However, most BLDC motors have three phase star connected stator.

Each winding is constructed with numerous interconnected coils, where one or more coils are placed in each slot. In order to form an even number of poles, each of these windings is distributed over the stator periphery.

Advantages of BLDC Motor

BLDC motor has several advantages over conventional DC motors and some of these are

- It has no mechanical commutator and associated problems
- High efficiency due to the use of permanent magnet rotor
- High speed of operation even in loaded and unloaded conditions due to the absence of brushes that limits the speed
- Smaller motor geometry and lighter in weight than both brushed type DC and induction AC motors

- Long life as no inspection and maintenance is required for commutator system
- Higher dynamic response due to low inertia and carrying windings in the stator
- Less electromagnetic interference
- Quite operation (or low noise) due to absence of brushes

Disadvantages of Brushless Motor

- These motors are costly
- Electronic controller required control this motor is expensive
- Not much availability of many integrated electronic control solutions, especially for tiny BLDC motors
- Requires complex drive circuitry