ASSIGNMENT-1

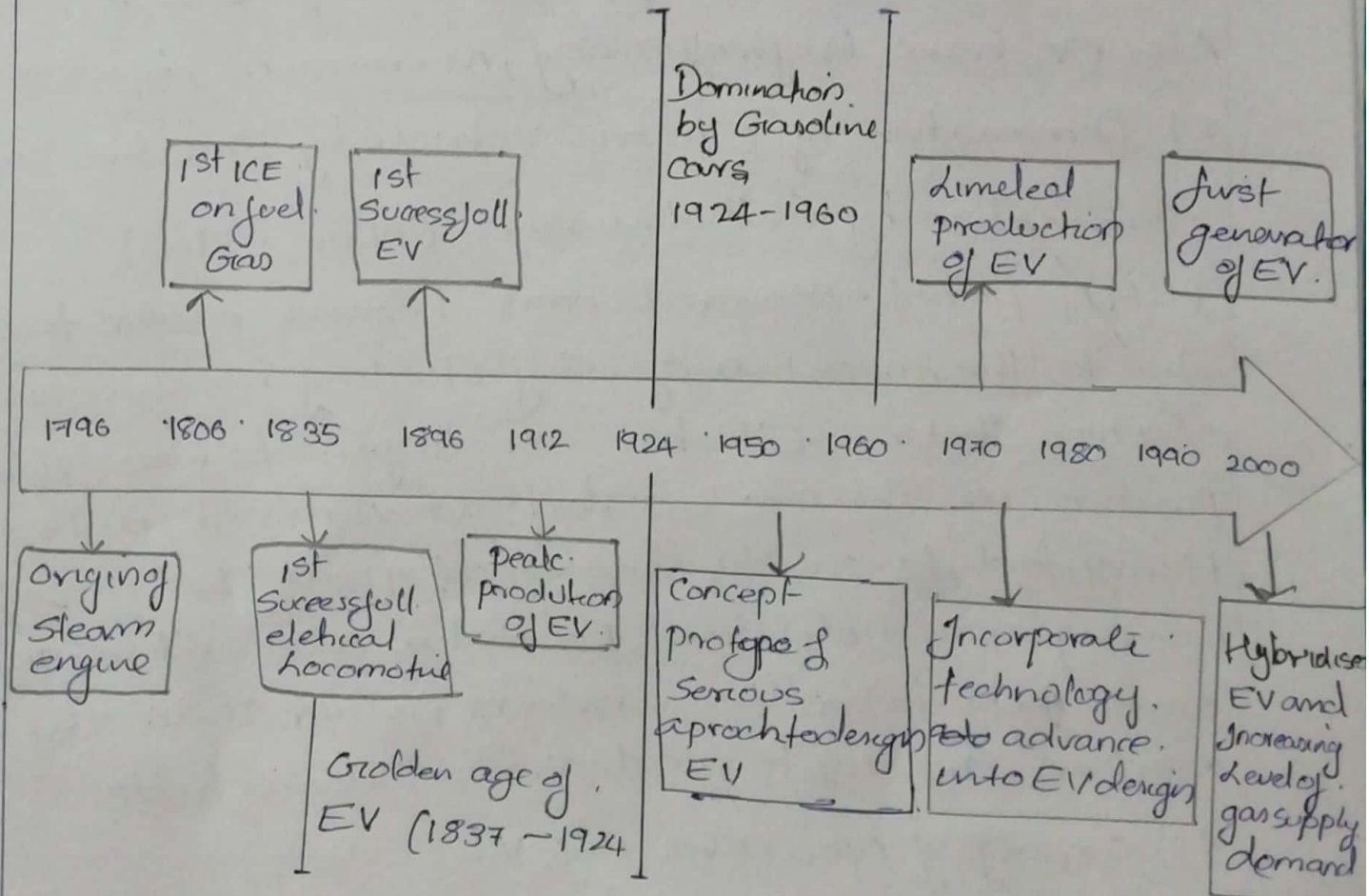
Havi Shankar-C

1. a) Invention of Electric motor.

World's first electric motor is made by Anyos Jedlik in 1828. 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.

In 1835; professor Sibrandus Stratingh of groninger, The Netherlands and his assistant Christopher Becker from germany also created a small scale electric car. powered by non rechargeable primary cells.

The first known electric locomotive was built in 1837. by chemist Robert Davidson of Aberdeen. The first successful electric vehicle was build in 1896 in US by william morrison.



b) Golden Era of EV. (1837 - 1924)

In 1906 electric vehicle have became really poppula
In 1906 an eletric vehicle is produced with The range of 100miles in a single charge., and also get Speed of 45-50 km/h. In begining of 1900 Electric Cars were even Labelled as "women's cars".
At The turn of The century, 40% of American cars were powered by Steam, 38% by eletricity and 22% by petrol. Commercial eletric vehicles were produced primarily in Europe.
The main reason for popularity of EV in 1906 are.
Steam engine take 45minuts to starts, IC engine takes 15minuts to start but EV have are quick start vehicles
Also EV have high efficiency, No emission, Low cost.

c) Domination of Electric vehicle by Grasoline cars.

Domination by Grasoline cars (1924 - 1960)

In 1912 petrol-powered cars became easier to drive due to The Invention of Self starting mechanism "electric Stater". Electric car began to Lose Their Position in The car market at America in 1920. Henry ford famously remarked That The use of The moving arrembly line production allowed for The work to be taken to workers rather Than The workers moving to and around The vehicle.

d) Coming of New Era in EV.

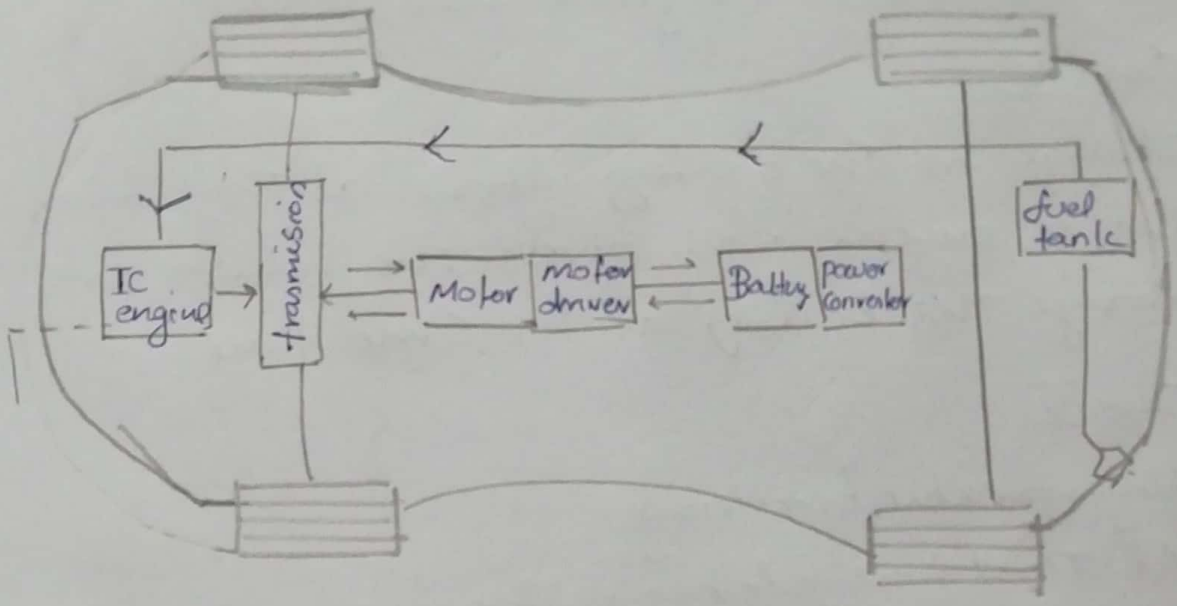
The energy crises in 21 century. Led to renewed Interest in electric cars. A Lot of Small companies.

Started to design and advertise small electric cars in to The public Toyota offered its RAV4-EVS in year. 22nd November 2002. Calyornian manufacturer of electric car Tesla motors in 2004 started The development of The Tesla Roadster model. Tesla was also The. first to introduce Lithium Jon batteries in its car. production. In 2022. many MNC had taken initiative for green mobility and EV vehicles suchas TATA. motors, kinetic ~~energ~~ green., mahindra electra are. Such of Them.

e) Introduction to of Hybrid electric vehicles.

A hybrid electric vehicle HEV is a type of hybrid vehicle That combines a IC engine System with an electric propulsion System. The presence of. electric powertrain is intended to achive either. better fuel economy Than an conventional vehicle There is a Variety of HEV. types and The gerge degree to wheeh each function as an electric vehicle also varies. HEV Cam be classified based on The. hybrid architecture. and degree of hybridization. Based on hybrid architecture. HEV cam classified into Series, parallel, Series parallel. Based on The. degree. of hybridization HEV cam classified into. micro, mild and full hybrid.

2. b) Parallel Hybrid Electric Vehicles



Parallel hybrid EV Consist of IC engine and electrical motor. The battery used to drive the electrical motor is charged with the help of IC engine Primary machine in parallel HEV is IC engine and the Secondary machine is motor. Fuel is Stored in the fuel tank to drive the IC engine There is 5 types of cases in parallel HEV.

case I :-

In this case Vehicle is driven with the help of IC engine only. ~~motor is not~~

Case II :-

In this case vehicle is driven with the help of electrical motor only. In this case the vehicle is BEV Battery electrical vehicles.

Case III

Hybrid mode. In this case both IC engine and

motor is in the operational conditions.
Output from the IC engine and motor is given to the trasmission (hybrid mode).

Case IV

Charge in the battery is low at that time the IC engine will drive the vehicle and charge the battery at the same time.

Case V :

Regenarative breaking.
At that time eletric motor will act as a genarator.

Advantages :-

1. Reduced traction motor size.
2. No need of extra genarator.
3. Use a smaller battery pack than serie drive trains

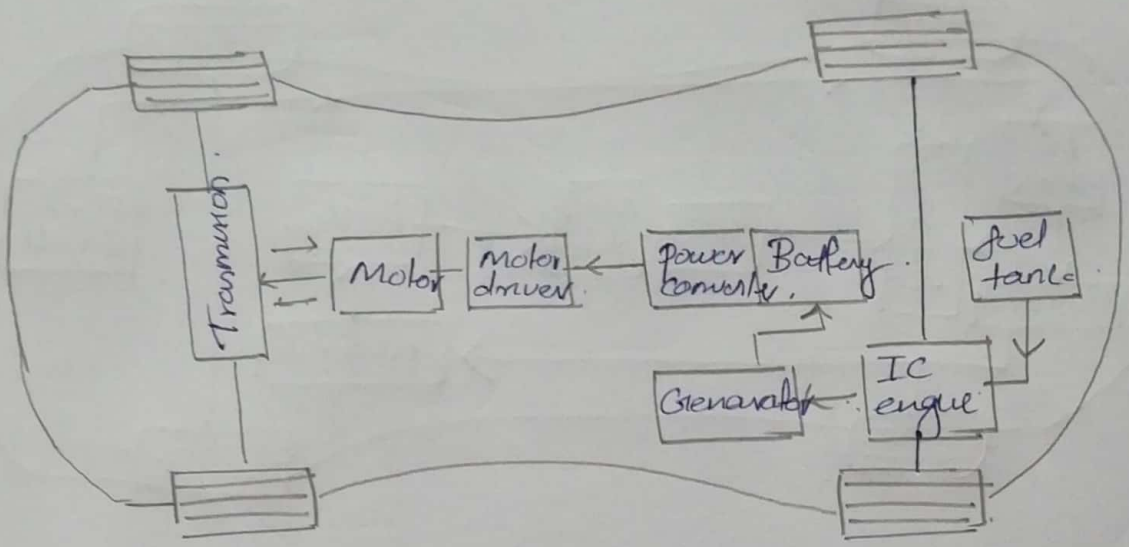
Disadvantages :-

1. Additional weight.
2. High cost when compared to ICE vehicles.
3. Complexity.

Application :-

1. Honda insight
2. Honda civic hybrid.
3. Mercedes - Benz S400 BLUE HYBRID.

a) Series Hybrid Electric Vehicles.



In series hybrid EV. The primary machine is motor. and The secondary machine is IC engine. An. extra genarator is provided This series HEV to. charge The Battery; The genarator is operated with The help of IC engine; So IC engine is used. to ~~str~~ recharge The battery.
In series Hybrid EV. motor is powerfull and. have large battery pack.

Advantages:-

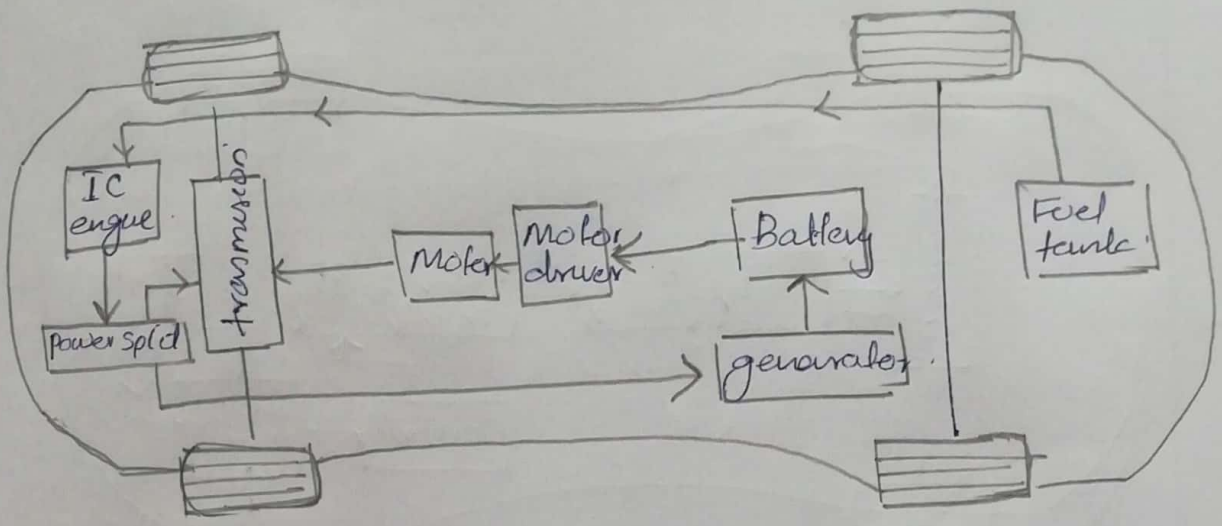
1. Low fuel Consoption Compared to That of parallel HEV
2. The combustion engine can operate in a narrow rpm range.

Disadvantages:-

1. Additional weight and cost due to ~~more~~ added Components.
2. Complexcity.

Application:-
1. Audi A8
2. Lexus NX

c) Series parallel Hybrid vehicle.



In series parallel hybrid vehicles motor as well as IC engine is used to drive the vehicle. A powersplit is used to split the power from IC engine. An extra generator is also used to recharge the battery. when battery is low; the battery is charged by ~~giving~~ directing power from the Powersplit to the generator.

If we want to charge the battery but we want to use IC engine to drive the vehicle at the same time. powerSplit is used to split the power to both. This combination only used by Toyota prius.

Advantages:-

1. Engine and motor can provide power independently or in conjuction with one another.
2. Engine can supplement the motor when additional power is required.

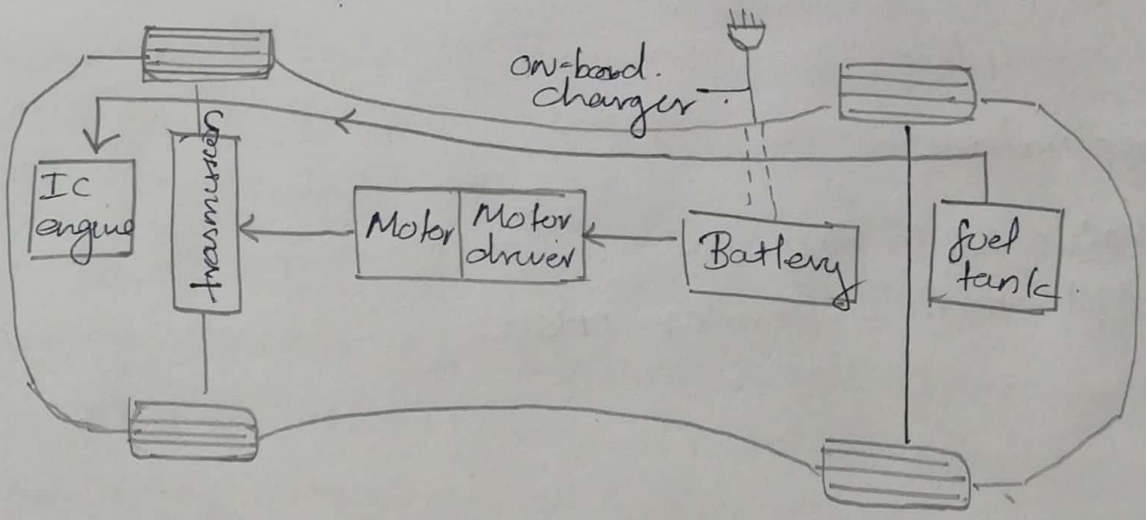
Disadvantage :-

1. Complicated Control Scheme.
2. Requires complex programming
3. Increased cost.

Application :-

1. Toyota prius

d) Plug in Hybrid electric vehicle (PHEV).



A plug-in hybrid EV is a hybrid EV whose battery packs can be recharged by plugging a charging cable in to an external electric power source, in addition to internally by its on board internal combustion engine-powered generator. most PHEV are panengercar There is no need of extra generator to charge.

The battery. charging of battery can be done. with the help of charging station. or Home charging setup. output of motor and IC engine is given to the trasmission.

Advantages:-

1. more efficient engine; resulting in lower fuel consoption and lower CO_2 emission.
2. more dynamic
3. Reduce toxic exchaust gases.

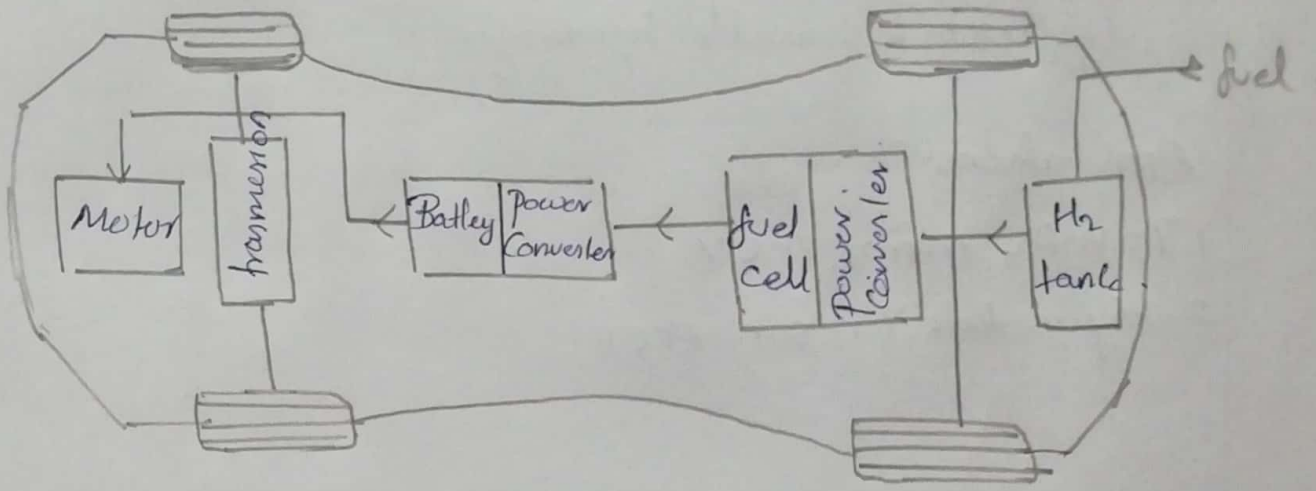
Disadvantages.

1. more weight
2. Expensive
3. complex.

Applications;-

1. Volvo XC90 plug-in
2. Mitsubishi Outlander PHEV.

c) Fuel cell Electric Vehicle.



In fuel cell elatric vehicle; instead of using IC engine fuel cell is used to charge the battery. motor is driven with the help of the battery. H_2 fuel tank is also provided to store hydrogen fuel.
fuel cells in vehicles generate elel electricity generally using oxygen from the air and compressed hydrogen. most fuel cell vehicles are classified as zero emission vehicles that emit only water and heat. fuel cell is a device that generates electricity through an electrochemical reaction, not combustion.

Advantages

1. Simplest fuel cell system
2. Good load response.
3. zero emission system.

Diradvantages :-

1. high cost
2. large size
3. difficulty to handle hydrogen.

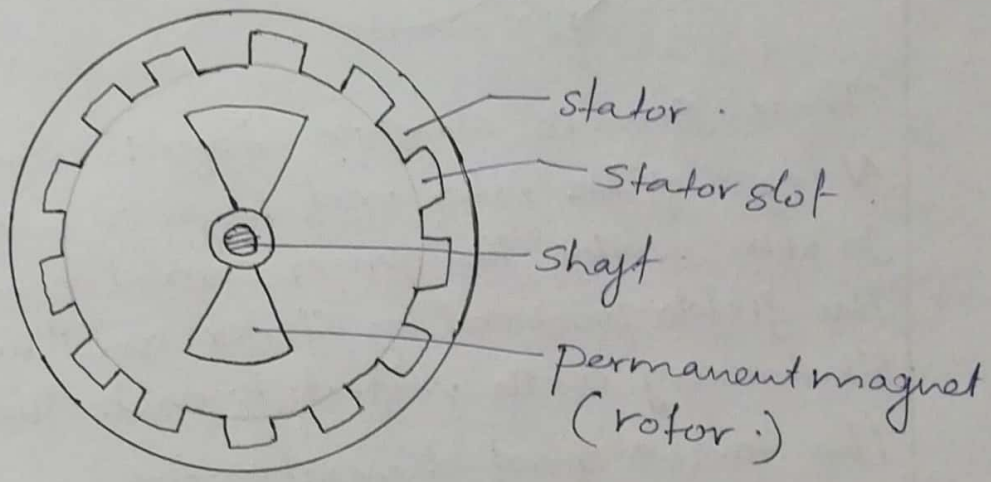
Applications :-

1. Toyota Mirai FCEV
2. Hyundai Tucson FCEV.

3 Brushless DC motor (BLDC)

Brushless dc motor is an electric motor powered by a direct current voltage supply and commutated electronically instead of by brushes like in conventional DC motors. This motor is worked with the help of DC supply. Due to the absence of brushes maintanance is less.

Construction of Brushless DC motor :-

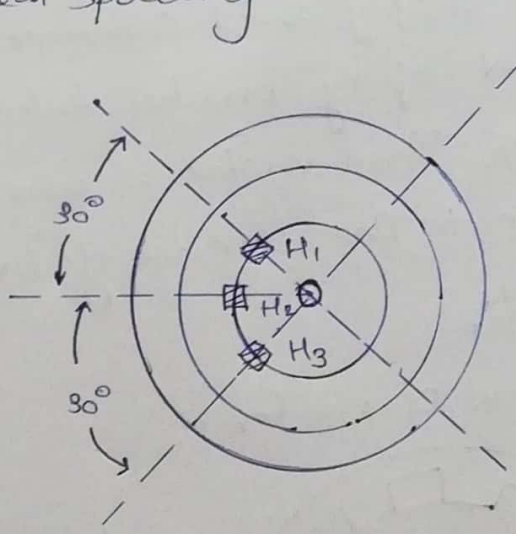


Stator of BLDC motor has 3 phase winding while rotor is in the form of permanent magnet. Brushless DC motor also have rotor positioning sensor which produce electrical signal that indicate the current correct position of the rotor. Brushless. Stator winding is driven from an electronic drive which is a 3phase inverter

Speed of brushless DC motor can be controlled by controlling its stator voltage which can be achieved by controlling the dc input voltage of the inverter.

Sensors :-

The PMDC motor use Hall sensors with 60° electrical spacing.



Hall sensors.

These sensors produce logic 1 when exposed to N-type of the rotor and logic 0 when no exposing In BLDC motor the armier circuit operate on dc supply The fields produced by Stator and rotor remains. Stationary with respect to each other.

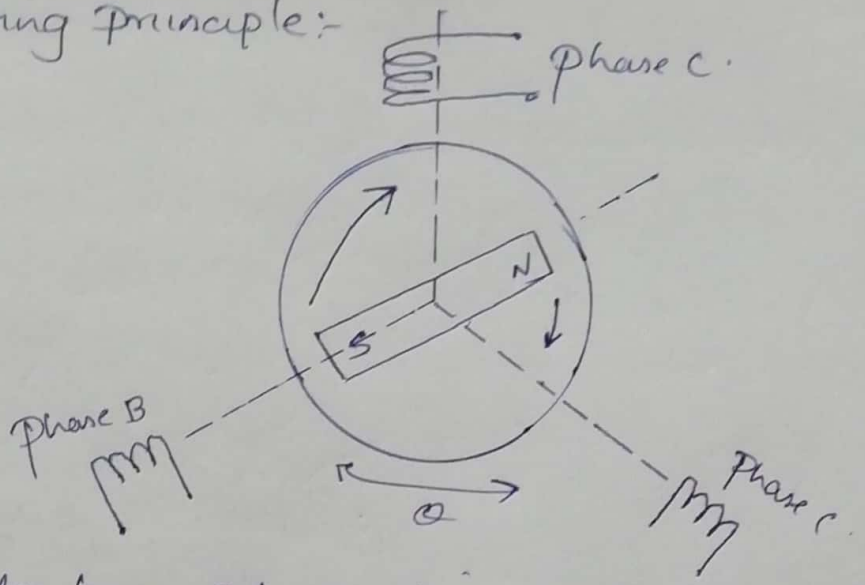
The torque speed characteristics are similar to that of a dc motor. This motor does not have brushes.

Two types of BLDC motor are There :-

#1. Unipolar (half wave) BLDC motor.
#2. Bipolar (full wave) BLDC motor.

Application of BLDC motor are
Computer peripheral equipments.
Instrumentation and control system.
Electronic power steering
Air conditioners.

Operating Principle:-



Stator have 3ϕ winding phase A, B & C ; 120° phase shift when over. phase A is energized stator poles south and north are created. The Stator's south pole repels rotors South pole and attract rotor north Pole. Due to this attraction and repulsion clockwise torque is produced.

The magnitude of torque is given by:-

$T = K\phi_S\phi_R \sin\alpha$.

K = constant.

ϕ_S = field flux Stator.

ϕ_R = field flux rotor.

The torque is directly proportional to the sinusoidal α The magnitude of Stator field flux is proportional to. Stator current I_1 and rotor field is constant

$T = K_1 I_1 \sin\alpha$

The Stator phases are energized in the sequence. A, B, C, & A So The clock wise rotation will be found.