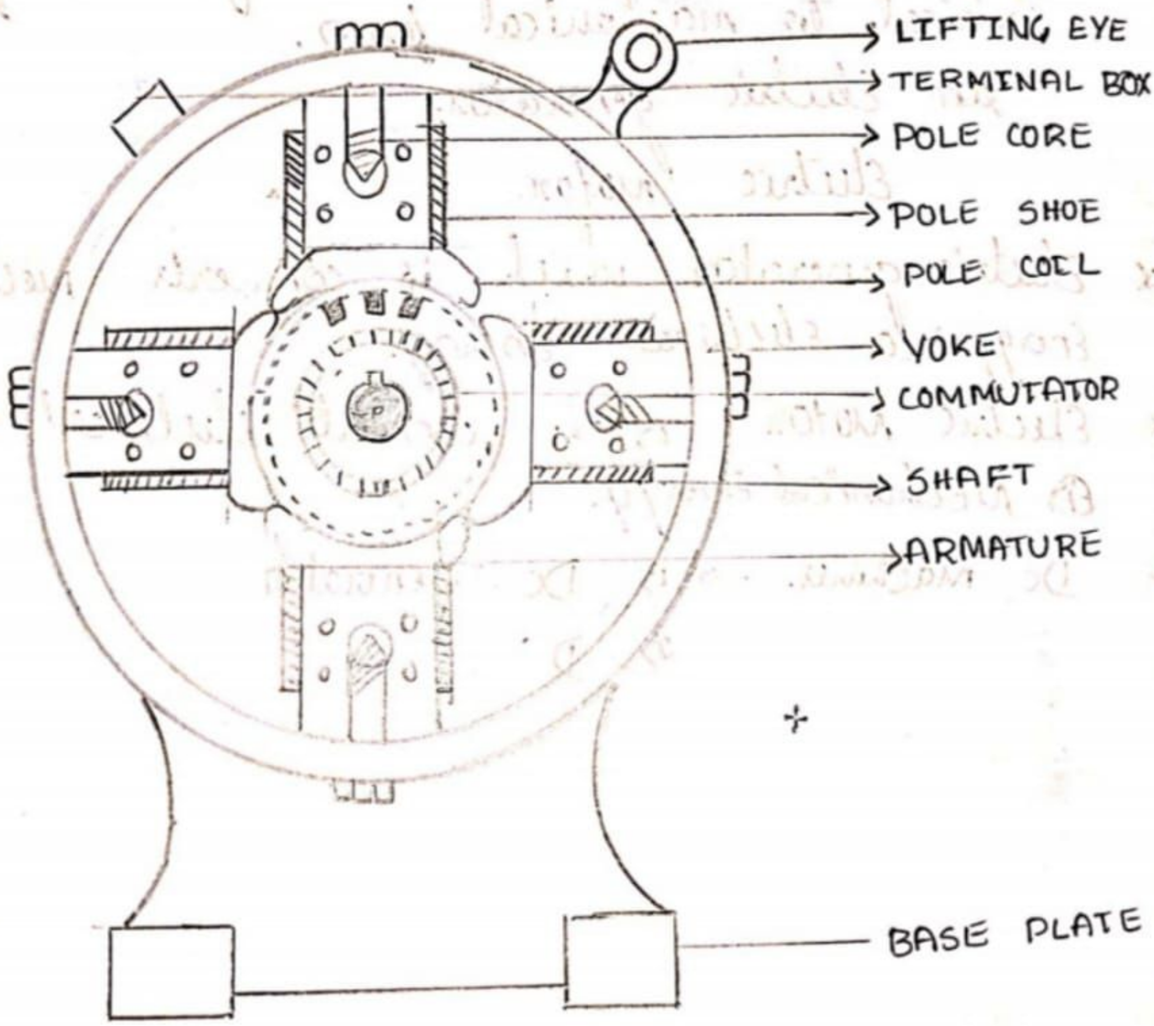
1) ~~wth~~ with the neat sketch, explain construction of a DC machine.



D.C Machine

1) Yoke

a) functions

* It serves the purpose of outermost cover of the DC machine. So that the insulting materials get protected from harmful atmospheric Element like moisture, dust and various gases, acidic fumes etc.

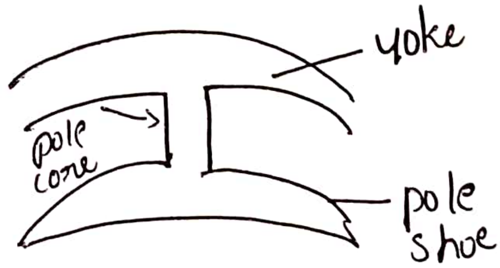
* It provides mechanical support to the poles.

b) Choice of material: It is prepared by using cast iron because it is cheapest and provides low reluctance path. For large machines rolled steel, cast steel, silicon steel is used which provides high permeability i.e low reluctance and gives good mechanical strength

2) poles.

* Each pole is devided into two parts namely, pole core and pole shoe

* figure shows pole structure



a) function of pole core and pole shoe

* pole core basically carries a field winding which is necessary to produce the

flux.

* It directs the flux produced through air gap to armature core, to the next pole
* pole shoe enlarge the area of armature core to come across the flux, which is necessary to produce larger induced emf To achieve this! pole shoe has been given a particular shape.

b) Choice of material: It is made up of magnetic material like cast iron or cast steel.
As it requires a definite shape and size, laminated construction is used. The laminations of requires size and shape are stamped together to get pole which is then bolted to the yoke.

3> Field winding :-

* The field winding is wound on the pole core with a definite direction

a) Functions.
* The field winding carries current and behaves as an electromagnet, producing necessary flux.
* As it helps in producing magnetic field. i.e exciting the pole as an electromagnetic it is called field winding.

4) Armature :- The armature is further devided into two parts 1) Armature core :- Armature core is cylindrical in shape mounted on the Shaft. It Consist of slots on its periphery and the air ducts to permit the air flow throug-h armature which serves cooling purpose.

2) Armature winding :- Is nothing but the interco-nnection of armature conductors, placed in the slots provided on the armature core periphery.

5) Commutator :-
* the basic nature of emf induced in the armature conductor is alternating.
* this needs rectification in case of D.C generator, which is possible by a device called commutator.

6) Brushes and Brush gear.
* Brush are stationary and resting on the surface of the commutator

2) Brief on the Characteristics of a DC series and Shun motor with neat plots.

→ 1) The characteristics of DC motor are studied keeping the applied voltage constant. There are three important characteristics.

1) Armature torque vs. Armature current :
   T_a vs I_a.
2) speed vs armature current characteristic :
   N vs I_a
3) speed vs Torque : N vs T_a.

2) Characteristics of shunt motors.

1. Armature torque. Vs Armature current.

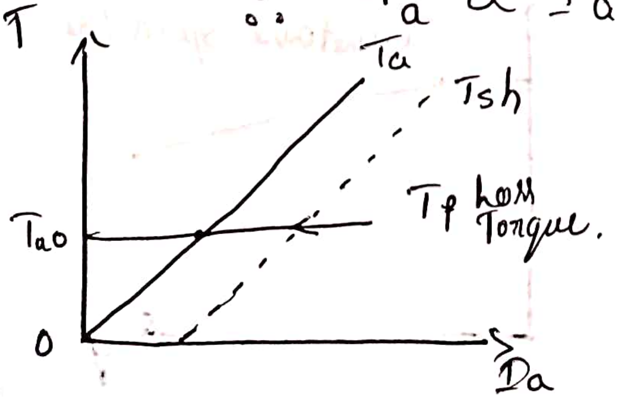
* from torque Equation
  $T_a \propto \phi I_a$

* Now ϕ is the flux ~~proportional~~ produced by the field winding and proportional to the current passing through the field winding.

$\phi \propto I_{sh}$

* For a constant values of R_{sh} and supply voltage V, I_{sh} is also constant and hence flux is also constant.

$\therefore T_a \propto I_a$



Ta Vs I_s

* The Equation represents a straight line passing through the origin.
* Torque increases linearly with armature current, so as load increases, armature current increases increasing the torque developed linearly.

2. Speed Vs Armature current.

* we have the back emf $E_b = \frac{\phi P N Z}{60 A}$

hence we can write be

$$E_b \propto \phi N.$$

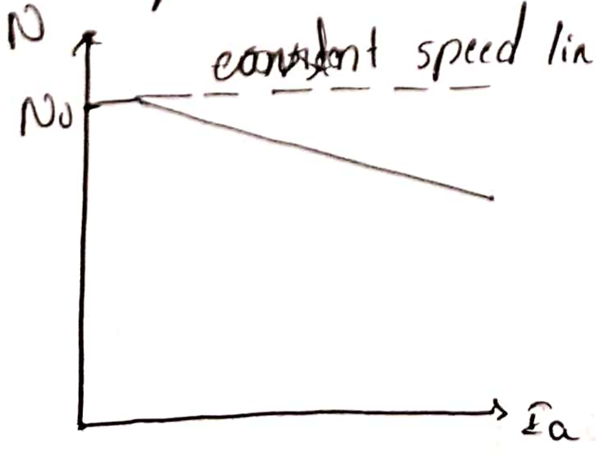
$$\text{ie} \quad N \propto \frac{E_b}{\phi}$$

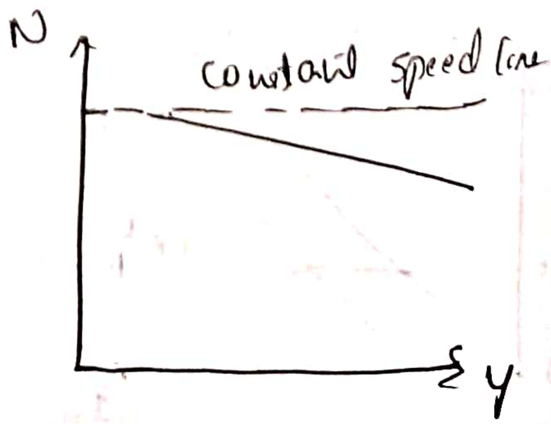
$$\therefore E_b = V - I_a R_a$$

For shunt motor.

$$N \propto V - I_a R_a$$

* so as load increases, the armature current increases and hence drop. $I_a R_a$ also increases.
* But as R_a is very small, for change in I_a from no load to full load, drop $I_a R_a$ is very small and hence drop in speed is also not significant from no load to full load.





3) Speed Vs. Armature torque.

* These characteristic can be derived from the above two characteristic.

* This graph is similar to speed - armature current characteristic as torque is proportional to armature current.

3) A 6 pole lap - connected DC series motor, with 864 conductors, take a current of 110 A at 480 V. the armature resistance and the series field resistance are 0.18 ohm an 0.02 ohm respectively. The flux per pole is 50 mwb. Calculate the speed and the gross torque.

→

$$E_A = V_T - I_A R_A = 480 - 110 \times 0.2 = 458\text{ V}$$

$$N = 636\text{ rpm}$$

$$E_A = \frac{\phi Z N}{60} \times \frac{P}{A}$$

$$= \frac{0.05 \times 864 \times N}{60} = 458$$

$$T_\alpha = 9.55 \frac{E_A I_A}{N}$$

$$= 9.55 \frac{458 \times 110}{636}$$

$$\simeq \underline{\underline{756\text{ N.m}}}$$