Emec

Experiments :-

✓ 1) Measurement of 3-ϕ power using two wattmeter method

✓ 2) Perform measurment of reactive power using single wattmeter method.

✓ 3) Determination of magnetization characteristics of separately excited DC generator at rated speed.

4) to perform Scott connection of transformer.

✓ 5) To study parallel operation of transformers.

(1) 3-ϕ power using two wattmeter method.

Connection :- Current coils of the two wattmeter are connected in series on any 2 lines & corresponding pressure coil is connected ~~[illegible]~~ in the ~~[illegible]~~ 3^rd^ line on which no ~~watt~~ current coil is connected.

6) To study DC motor starters

7)

① 3-ϕ power by two wattmeter method.

- Connection: Current coil is connected in series with any of the two lines & pressure coil on the 3rd line in which no current coil is connected.

- Current coil: 1) made up of thick wire & fewer no. of turns.
  2) works as ammeter

- Pressure coil: 1) Thin wire & high no. of turns
  2) Works as voltmeter

- Wattmeter: Measures active power $= VI\cos\phi$

Derivation :

Power $= W_1 + W_2$

& $W = VI\cos\phi$ (2 wattmeter method → load balanced)

~~WP = CSRVRB~~

$W_1 = I_L V_L \cos(30-\phi)$

$W_2 = I_L V_L \cos(30+\phi)$

$\therefore W_1 + W_2 = \sqrt{3} V_L I_L \cos\phi$

Purely resistive	Mixed	Purely reactive
↓	↓	↓
$\phi = 0$	$\phi = 60$	$\phi = 90$
$\cos\phi = 1$	$\cos\phi = 0.5$	$\cos\phi = 0$

- Most versalite method?

↓

2-wattmeter method

- ~~Why not 1 or 3 wattmeter method~~?

Why not 1 or 3 wattmeter method?

- 1 Wattmeter ⇒ Simultaneous measurements are not possible because we need to move wattmeter for readings

Ans: In Δ :- As I_L & I_P are different in Δ ∴ we need to connect the wattmeter across phase ∴ we won't have the external connection to measure power.
~~Δ connections will be treated to open of~~ current coil connection

- Cannot be used in unbalanced condⁿ
- Availability of (N) is must in ✩ connection

- 3 Wattmeter ⇒ (Suitable for 3ϕ 4-wire system)
  - Not economical
  - Same prob. in Δ as 1 W method
  - Availability of (N) is must in ✩

- Drawbacks of 2 W method :-
  - Not suitable for 3ϕ - 4 wire system

- Unit of active power : kW ($VI\cos\phi$)
- Unit of reactive power : kVAR ($VI\sin\phi$)
- Unit of apparent power : kVA (VI)

(2) Reactive power using single wattmeter

<u>Connection</u>: Current coil of wattmeter is connected in any one line & the pressure coils across the other two lines.

- Wattmeter reading = $V I \cos\phi$

here phase angle b/w V_{YB} & $I_R = 90-\phi$

$\therefore W = V_L I_L \cos(90-\phi)$

$W_R = V_L I_L \sin\phi$

totaly 3ϕ reactive power = $\sqrt{3} V_L I_L \sin\phi$

↓

+ve for inductive

-ve for capacitive

(3) Magnetizing characterstics of DC ~~Shunt~~ generator.

↳ To draw open circuit characterstic curve

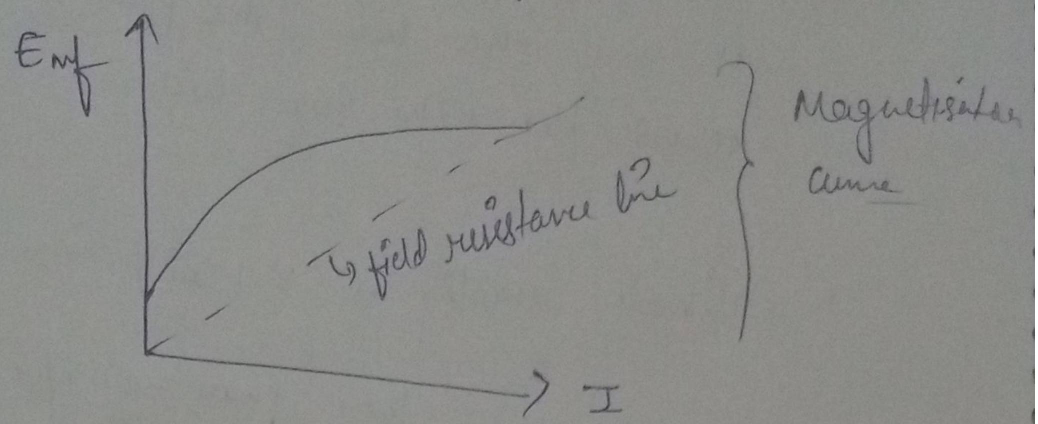
- DC generator is an electrical machine that convert mechanical energy of a prime mover into direct electrical energy

(It uses V generated by machine to establish current which gives rise to magnetic field)

Prime mover – machine that converts energy into work.

Ex – Turbines

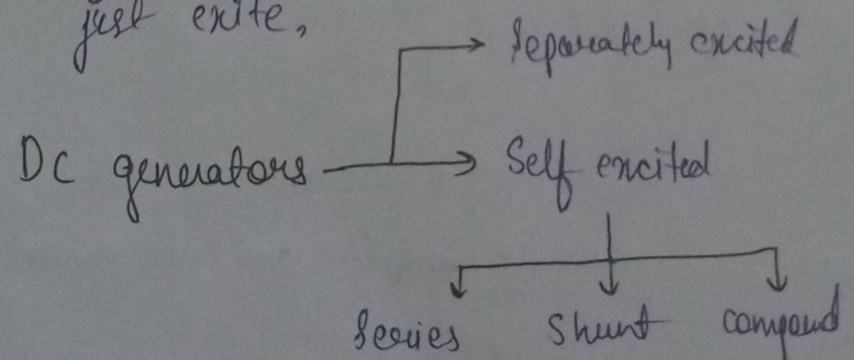
OC characteristics :- Relation b/w induced emf at no load and field current.



Why bending of curve?

When there is current flowing in the field winding, the emf induced due to residual flux is present in the machine. If field current ↑, flux ↑ linearly resulting into linear ↑ in emf but after a certain value of current, the saturation causes slower ↑ of field current which results in bending.

- Critical field resistance :-
  The max^m field circuit resistance for a given speed with which the shunt generator could just excite.

- 

(4) Parallel operation of two single phase transformer

↳ Power sharing b/w 2 single-ϕ transformer in parallel operation.

~~Nee~~ <u>Need of ||el operation</u> :-

When ~~th~~ an existing transformer is not able to withstand the ~~inc~~ sudden increased demand, in that case using that transformer will cause overheating & degrade its expected life. ~~In~~ There, instead of replacing it with ~~an~~ entirely new high capacity unit, it's better to add a smaller unit in parallel to ~~compliment~~ the existing one. And now this parallely connected ~~t~~ unit will be able to ~~p~~ meet the increased demand of power.

Requirements for ||el connection :-

- Polarity of both transformers must be same
- No load P & S voltage ~~should~~ of 2 transf. should ~~not~~ have appreciable diff in magnitude & phase.
- The per unit impedance of 2 trans. on their respective base must be equal.

(5) To perform separation of constant losses in a DC shunt machine.

Constant losses :- Iron losses which include eddy current loss & hysteresis loss.

Eddy current loss :- loss produced by ~~circulating~~ eddy current is known as eddy current loss. The eddy current induces because of variable magnetic field & conductors.

Hysteresis loss : The work done by the magnetising force against the internal friction produces & this energy which is wasted in form of heat is called Hysteresis loss.

it's caused by magnetising & demagnetising of the core as current flows in forward & reverse dir^n

• Commutator :

→ It reverses the current dir^n periodically b/w rotor & external circuits & i.e. generates rotating torque.
⇓
DC motor

→ It converts the AC into pulsating DC & insures that current in generator always flows in one direction
⇓
DC generator

(6) Scott connection

↳ Method of ~~connecting~~ connecting two single ϕ transformer to perform 3ϕ to 2ϕ conversion.

- One of the transformer is centre tapped & is called main transformer & the other is called teaser transformer.

$\Rightarrow$ (P) is tapped $\frac{\sqrt{3}}{2}$ times $\Rightarrow$ Voltages equal

3.3. TYPES OF DC MACHINE

The dc machines are classified into the following group, as per the connection of field winding with armature winding.

1. Separately excited dc machines – The field winding is connected to a separate dc source and has no direct connection with the armature winding.

2. DC shunt machines – The field winding is connected across the terminals of the armature winding. The shunt field coils are wound with many turns of fine wire, as a result the resistance of shunt field winding is appreciably high (of the order of 150 to 250 Ω). The current in the shunt field winding is due to the voltage generated/applied across the armature terminals.

3. DC series machines – The series field winding is connected in series with the armature winding. The series field coils are wound with few turns of wire of large cross-sectional area, as such the resistance of field winding is very low. Series generators will excite only when the load circuit is completed.

4. DC compound machines – Consisting of two field windings i.e. series winding connected in series with the armature winding and shunt winding connected across the armature winding. Both these windings are accomodated on the main pole, as such field magnets are excited partly by shunt field winding and partly by series field winding.