$$\cancel{500 = \frac{50\times10^{-2}\times12\times N\times8}{60\times8}}$$

~~N = 1~~

$$\overset{10}{\cancel{500}} = \frac{\cancel{50}\times10^{-3}\times\overset{8}{\cancel{480}}\,N\times\cancel{8}}{\cancel{60}\times\cancel{8}}$$

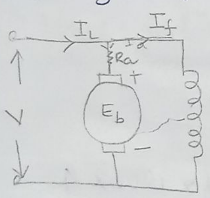
$$N = \frac{10^4}{8} = \frac{\overset{2500}{\cancel{10000}}}{\cancel{8}_2} = \underline{1250\,rpm}$$

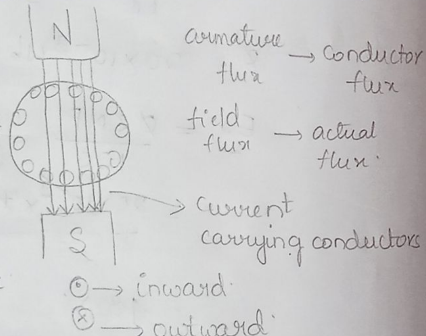
B
E
E

03/08/2022

* DC MOTOR:

Whenever we place a current carrying conductor in a magnetic field; there is a force developed.





Interaction b/w armature & field flux

$I_L = I_a + I_f$

$V = I_aR_a + \boxed{E_b}$ → back emf: opposes the source voltage

$\boxed{V - I_aR_a - E_b = 0}$

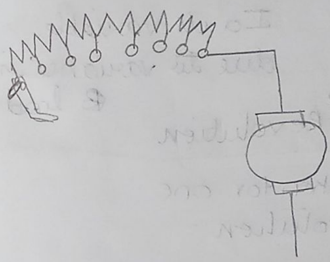
SHUNT MOTOR: $\boxed{E_b = V - I_aR_a}$ $\boxed{I_a = \frac{V - E_b}{R_a}}$

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

* $\boxed{E_b \text{ controls the current } I_a}$

If $E_b = 0$; $N = 0$

$$\boxed{I_a = \frac{V}{R_a}}$$



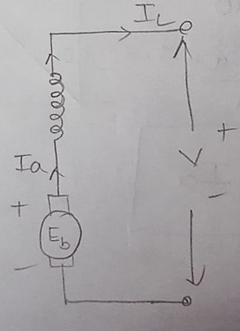
Starter is used to limit the starting current

$$I_a = \frac{V - E_b}{R_a}$$

* We need to limit the starting current to avoid the damage to the circuit

* Also at the beginning $E_b = 0$
∴ current I_a is very high; to control this current; starter is used $\boxed{I_a = \frac{V}{R_a}}$

* SERIES MOTOR:



$I_L = I_{sc} = I_a$

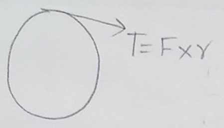
$E_b - I_aR_a - V = 0$

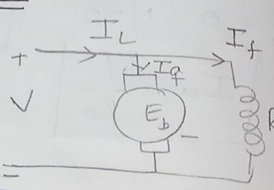
$\boxed{E_b = I_aR_a + V}$

$\boxed{I_a = \frac{E_b - V}{R_a}}$

06/08/2022

* TORQUE IN DC MOTOR:





$I_f = \frac{V}{R_f}$

$$\boxed{P_m = E_b I_a}$$

I_a is variable due to variance in load.

Power = $\frac{\text{Workdone / Revolution}}{\text{Time taken for one revolution}}$

$= \frac{(F\times 2\pi r)/1}{60/N} = (Fr)\frac{2\pi N}{60}$

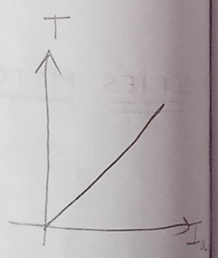
$= Fr\cdot 2\pi f = (Fr)\,\omega$

$$\boxed{P = T\omega}$$

$E_b I_a = T\omega$

$\frac{P\phi \cancel{N}}{\cancel{60}} \times \frac{Z}{A} I_a = T\cdot\frac{2\pi \cancel{N}}{\cancel{60}}$

$T = \frac{P\phi Z I_a}{2\pi A}$



$$\boxed{T = \frac{ZP}{2\pi A}\phi I_a}$$

$T \propto I_a$

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

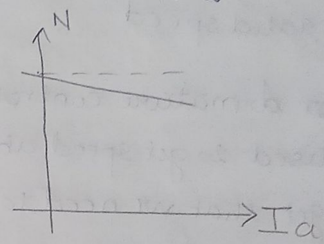
ϕ varies with I_f

$N \rightarrow$ varies.

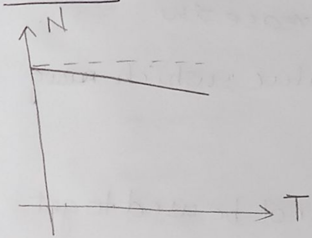
$$\boxed{N \propto \frac{E_b}{\phi}}$$

$E_b = V - I_a R_a$

$N \propto V - I_a R_a$



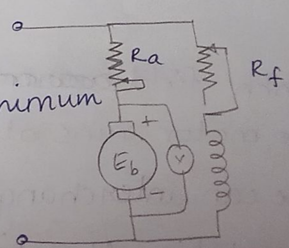
N v/s T



* Speed control of DC shunt motor (or) Separately excited DC Motor.

- We need start the circuit with a minimum speed

$N \propto \frac{E_b}{\phi}$



Va can be varied with armature resistance

Ra at max and R_f is max to start the circuit with min speed.

→ When the rated voltage and ~~[illegible]~~ field current are applied ; we get the rated speed.

~~for~~ Armature control method cannot be used to get speed above rated value. To get that we need to increase the resistance over rated value ; which ~~may~~ will damage the circuit.

B
E
E

Field control method cannot be used to get speed below rated value. To get that we need to increase the resistance over rated value.

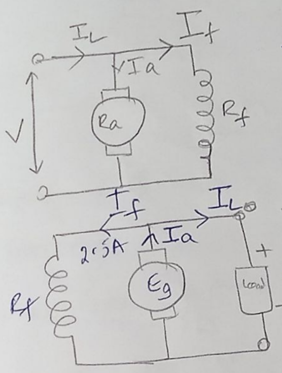
* When field ~~current~~ windings are opened the motor runs at a very high speed
* We can interchange the direction of the rotation of motor by either interchanging the armature (or) field polarities

10/08/2022

* $V = 250V$ $R_a = 0.12\Omega$ $R_f = 100\Omega$

$I_L = 80A$

$\frac{\text{Speed as generator}}{\text{Speed as motor}} = ?$



$I_f = \frac{V}{R_f} = 2.5A$

$I_a = 77.5A$ — flux in a shunt motor is constant due to constant V & I

$I_a = 80 + 2.5 = 82.5A$

Motor: $N_M \propto E_b$

Generator: $N_g \propto E_g$

$E_b = V - I_a R_a$
$= 250 - 77.5 \times 0.12$
$= 240.7V$

$E_g = V + I_a R_a$
$= 250 + 82.5 \times 0.12$
$= 259.9V$

$$\frac{N_g}{N_b} = \frac{259.9}{240.7} = 1.08$$

* $V = 200V$ $R_a = 0.4\Omega$ $I_a = 2A$ → no load current

$I_a = 50A$, $N = 1200rpm$ } → loaded conditions

$E_0 = V - I_a R_a = 200 - 2 \times 0.4$
$= 200 - 0.8$
$= 199.2V$

$E_1 = V - I_{a1} R_a = 200 - 50 \times 0.4$
$= 200 - 20 = 180V$

$N \propto \frac{E_b}{\phi}$

$$\frac{N_1}{N_o} = \frac{E_1}{E_o}$$

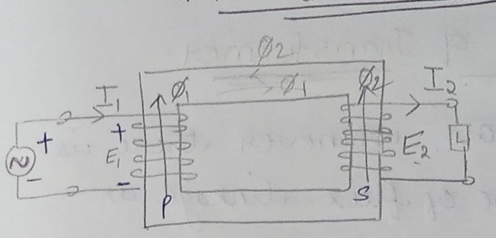
$$N_o = \frac{1200 \times 199.2}{180}$$

$$= \underline{1328 rpm}$$

B
E
E

10/08/2022

TRANSFORMERS



E_1 = Self induced emf

∵ emf is induced due to the source.

The transformer just step up or down the voltage; but total power on either side remains same $\boxed{V_1 I_1 = V_2 I_2}$

Due to the flux developed in primary coil there is a flux developed in secondary coil; $\boxed{E_2 = \text{Mutually induced emf}}$

Principle: Faraday's Law of electromagnetic Induction.

E_1 is time dependent/ varying voltage.

Lenz Law: Effect should oppose the cause.

- Constant flux machine.
- Whenever; there is no load; the reduction in initial flux ϕ_1 due to ϕ_2; therefore, the source supplies a flux ϕ_2' equal to ϕ_2 but opposite in direction.

∴ Therefore, the overall flux in the

transformer is ϕ_1

*EMF equation of Transformer:

By Faraday's law; whenever there is a rate of change of flux linkage in a conductor; there is emf induced.

BEE

$$\text{Avg emf/turn} = E_{avg/turn} = \frac{d\phi}{dt}$$
$$= \frac{\phi_m - 0}{\frac{1}{4f}}$$

$$\boxed{E_{avg/turn} = 4f\phi_m}$$

$$K_f = \frac{\text{Rms value}}{\text{Avg value}} = 1.11$$

$$\text{Rms value} = E_{rms/turn} = 4f\phi_m(1.11)$$
$$\boxed{E_{rms/turn} = 4.44 f\phi_m}$$

$$\boxed{\begin{aligned} E_1 &= 4.44 f\phi_m N_1 \\ E_2 &= 4.44 f\phi_m N_2 \end{aligned}}$$

*Transformer Ratio (K) $= \frac{E_2}{E_1} = \frac{N_2}{N_1}$

$K > 1 \rightarrow$ Step-Up Transformer

$K < 1 \rightarrow$ Step-Down Transformer

$K = 1 \longrightarrow$ Isolation Transformer.