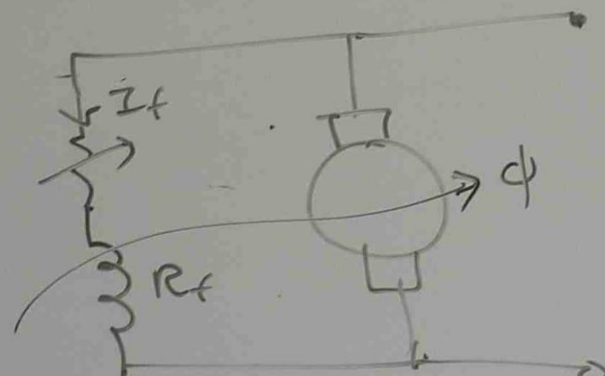
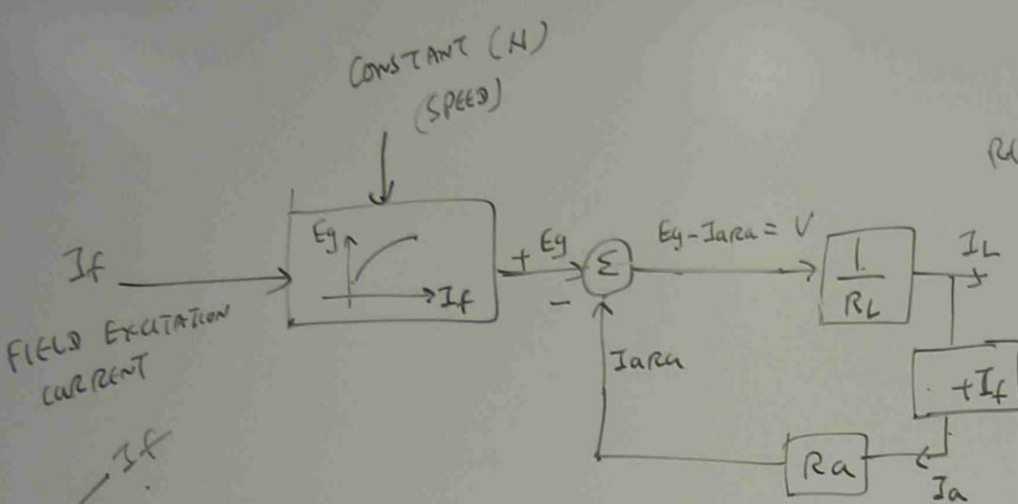
TRANSFER FUNCTION OF SELF EXCITED MACHINE

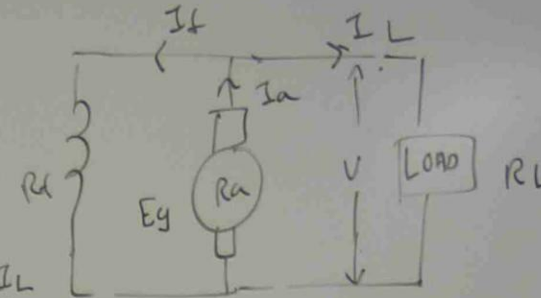
$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

ϕ = FIELD EXCITATION FLUX $\propto$ FIELD CURRENT (I_f)



BY ADJUSTING THE FIELD RHEOSTAT, FIELD EXCITATION CURRENT IS VARIED AND IT AFFECTS THE GENERATED VOLTAGE E_g.





$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

If

$$I_f \uparrow \rightarrow \phi \uparrow \rightarrow E_g \uparrow$$

TRANSFER FUNCTION

BLOCK DIAGRAM FOR

SELF EXCITED GENERATOR

$$E_g = V + I_a R_a$$

$$E_g - I_a R_a = V$$

$$\frac{V}{R_L} = I_L$$

$$I_a = I_L + I_f$$

$$I_a = \frac{V}{R_L} + I_f$$

ON

LATED

FROM THE TRANSFER FUNCTION,

(1) CHANGE OF FIELD EXCITATION CURRENT & SPEED AFFECTS Eg

(2) Eg IS RELATED TO TERMINAL VOLTAGE V

(3) TERMINAL VOLTAGE "V" IS RELATED TO LOAD CURRENT I_L AND " " ARMATURE CURRENT I_a

(4) $E_g - I_a R_a = V$

TRANSFER FUNCTION OF SELF EXCITED MACHINE

$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

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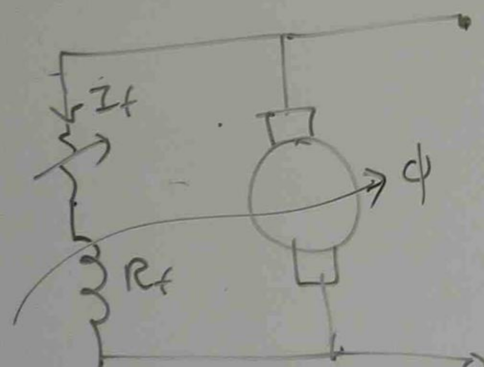
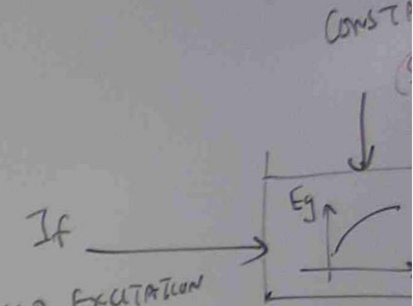




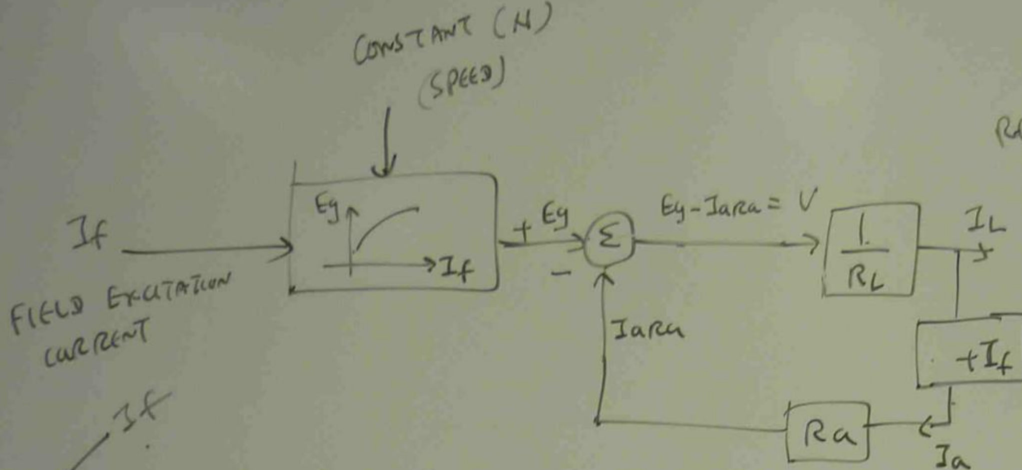
FIELD EXCITATION CURRENT

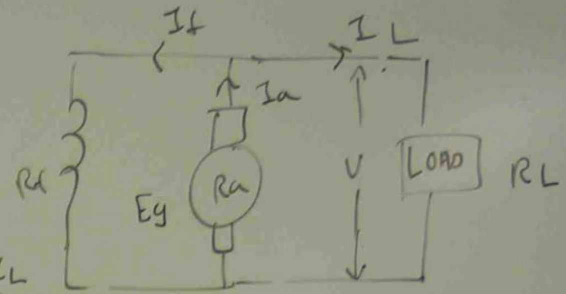
I_f

$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

$$I_f \uparrow \rightarrow \phi \uparrow \rightarrow E_g \uparrow$$

BY ADJUSTING THE FIELD RHEOSTAT, FIELD EXCITATION CURRENT IS VARIED AND IT AFFECTS THE GENERATED VOLTAGE E_g.





$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

I_f

$$I_f \uparrow \rightarrow \phi \uparrow \rightarrow E_g \uparrow$$

TRANSFER FUNCTION
BLOCK DIAGRAM FOR
SELF EXCITED GENERATOR

$$E_g = V + I_a R_a$$

$$E_g - I_a R_a = V$$

$$\frac{V}{R_L} = I_L$$

$$I_a = I_L + I_f$$

$$I_a = \frac{V}{R_L} + I_f$$

FROM THE TRANSFER FUNCTION,

(1) CHANGE OF FIELD EXCITATION CURRENT & SPEED AFFECTS E_g

(2) E_g IS RELATED TO TERMINAL VOLTAGE V

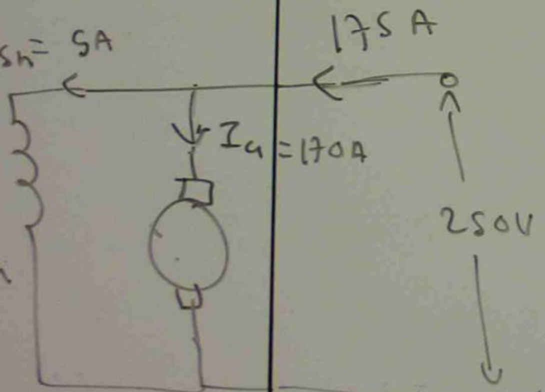
(3) TERMINAL VOLTAGE "V" IS RELATED TO LOAD CURRENT I_L AND ARMATURE CURRENT "I_a"

(4) $E_g - I_aR_a = V$

P) A 50 HP 250 V 1200 RPM SHUNT DC MOTOR HAS A RATED ARMATURE CURRENT OF 170 AMP AND RATED FIELD CURRENT OF 5 A. WHEN THE ROTOR IS BLOCKED, THE ARMATURE VOLTAGE 10V PRODUCES A 170 A CURRENT FLOW AND FIELD VOLTAGE 250V PRODUCES A FIELD CURRENT FLOW OF 5A. AT NO LOAD WITH TERMINAL VOLTAGE EQUAL TO 240V, THE ARMATURE CURRENT IS EQUAL TO 13.2 AMP, FIELD CURRENT 4.8A. MOTOR SPEED IS 1150 RPM.

(a) HOW MUCH POWER IS OUTPUT FROM THIS MOTOR AT RATED CONDITION

(b) MOTOR EFFICIENCY



$R_{sh} = \frac{V}{I_{sh}}$

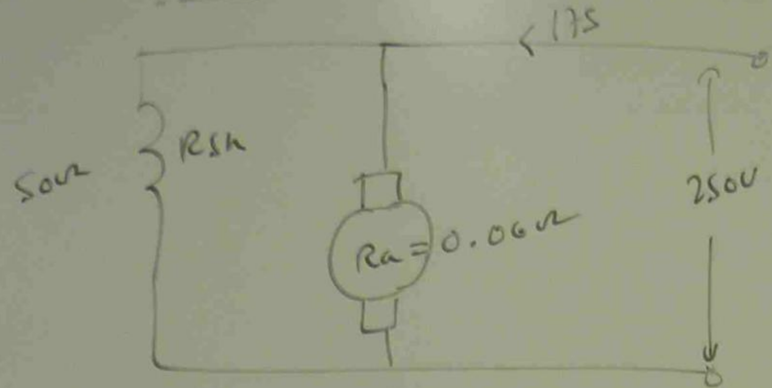
$= \frac{250}{5}$

$= 50\Omega$

BLOCKED ROTOR EQUIVALENT CIRCUIT

$R_a = \frac{V}{I} = \frac{10}{170}$

$= 0.06\Omega$



NO LOAD

ALL POWER LOSSES = ROTATIONAL LOSSES.

ROTATIONAL LOSS = TERMINAL VOLTAGE AT NO LOAD × NO LOAD ARMATURE CURRENT

$= 240 \times 13.2$

$= 3168\,W$

RATED CONDITION POWER OUTPUT

OUTPUT POWER AT RATED CONDITION = INPUT POWER — (COPPER LOSS + ROTATIONAL LOSSES)

$$\text{COPPER LOSS} = I_a^2 R_a + I_{sh}^2 R_{sh}$$

$$= (170)^2 \times 0.06 + (5)^2 \times 50 = 2984 \text{ WATT}$$

$$\text{INPUT POWER} = VI = 250 \times 175 = 43750 \text{ WATT}$$

$$\text{OUTPUT POWER} = 43750 - (2984 + 3168)$$

$$= 39593 \text{ W}$$

$$\text{Efficiency} = \frac{\text{OUTPUT}}{\text{INPUT}} \times 100 = \frac{39598}{43750} \times 100 = 90.5\ \%.$$

pb

A SIX POLE WAVE WOUND DC GENERATOR HAS 410 ACTIVE CONDUCTORS. IF THE GENERATOR IS DRIVEN AT 750 RPM, CALCULATE THE OPEN CIRCUIT VOLTAGE IF USEFUL FLUX PER POLE IS 0.03 wb.

$P = 6$ WAVE , $Z = 410$

$N = 750\,\text{RPM}$ $E_g = ?$

$\phi = 0.03\,\text{wb}$

$a = 2 \times n$ WAVE

$= 2 \times 1 = 2$

a = NO. OF ARMATURE PARALLEL PATHS.

$$E_g = \frac{\phi Z N}{60} \times \frac{P}{a}$$

$$= \frac{0.03 \times 410 \times 750}{60} \times \frac{6}{2}$$

$=$