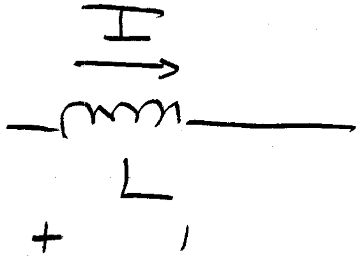
Review for MID term

Semi

Conpu[illegible]

S&C

[illegible]



$$E = \frac{1}{2} L I^2$$

$$V_L = L \frac{\Delta I}{\Delta t}$$

Special case faraday law

$$E = \beta l v$$

Lorenz Force

$$F = \beta l I$$

Faraday Law

$$E = N \frac{d\phi}{dt}$$

Lifting

$$F_g = 9.8 M$$

$$W = F * d$$

$$P = \frac{W}{t} = F * v$$

13

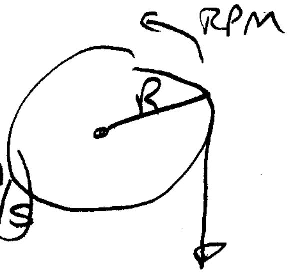
RPM → Linear speed

$$T = F * r$$

$2\pi R$

$\cdot C$

$$R \cdot \frac{1\,\text{min}}{60\,\text{sec}} = \left(\frac{m}{s}\right)$$



Power Triangle

Single Phase | **3 Phase**

$S_{1\phi} = VI$

S = Apparent Power

$S_{3\phi} = VI\sqrt{3}$

S = Apparent Power

$P_{1\phi} = VI \cos\theta =$ [illegible]
$= VI\,(pf) =$ [illegible]

$P_{3\phi} = VI\sqrt{3}\,\cos\phi$
$= VI\sqrt{3}\,(pf)$

P = Real Power
True Power
Active Power

$P = S\cos\phi$
$P = S\,(pf)$

$Q_{1\phi} = \sqrt{S^2 - P^2} = \sqrt{VI^2 - VI\cos^2\phi} = \sqrt{\ }$ [illegible]
$= \sqrt{VI^2 \cdot (1-\cos^2\phi)} = VI\sqrt{(1-\cos^2\phi)} = VI\sin\phi$
= [illegible]

Q = Reactive Power

$Q_{1\phi} = VI\sin\phi = S_{1\phi}\sin\phi$

$Q_{3\phi} = VI\sqrt{3}\sin\phi = S_{3\phi}\sin\phi$

Acceleration

if TL NOT given
ASSUME zero [illegible]
STATE

$$\Delta t = \frac{J \Delta n}{9.55\, T_a} \quad \text{where } T_a = (T_m - T_L)$$

$$E_k = \tfrac{1}{2} m v^2 = 5.48 \times 10^{-3} J n^2$$

DC Machines

$$E = \frac{Z n \phi}{60}$$

if ϕ constant

$$\frac{E_1}{n_1} = \frac{E_2}{n_2}$$

$$Z = (\#\text{ coils}) * \left(\frac{\#\text{ turns}}{\text{coil}}\right) * \left(\frac{2\text{ cond}}{\text{turn}}\right)$$

$$I_{Brush} = I_{DC} / \text{Brush Pairs} = I_{DC} / \text{pole Pairs}$$

$$I_{coil} = \tfrac{1}{2} I_{brush}$$

Motor Direction

① I_a or ② I_f Direction

NOT BOTH

Generator Polarity

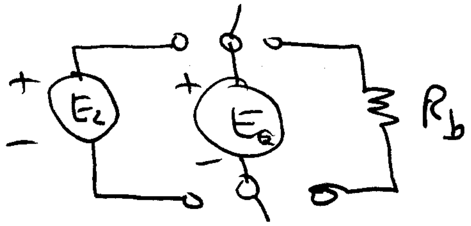
① direction of Rotation

② I_f direction

NOT BOTH

STOPPING DC Machine

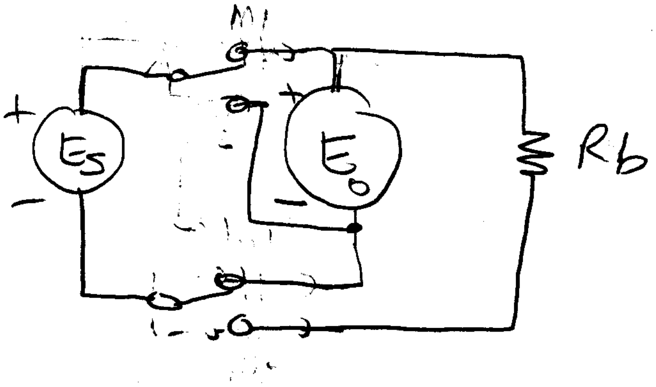
Dynamic Brake



$I_b = E_0/R_b$

$T_0 = \frac{J n_1^2}{131.5 P_1}$ = time to Reach ½ initial speed

Plugging



$I_b = \frac{(E_s + E_0)}{R_b}$

$P_1 = E_0 I_1$

$T_0 = \frac{J n_1^2}{131.5 P_1}$

Time To STOP = $2T_0$

Class	T_{max} (HOTSPOT)	$\Delta t_{max}^{HOTSPOT}$	T_{max} (AVG)	Δt_{max}^{AVG}
A	105 C	65 C	100 C	60 C
B	130 C	90 C	120 C	80 C
F	155 C	115 C	145 C	105 C
H	180 C	140 C	165 C	125 C

$$t_2 = \left(\frac{R_2}{R_1}\right)(t_1 + 234) - 234 \quad \text{(copper)}$$

$$t_2 = \left(\frac{R_2}{R_1}\right)(t_1 + 228) - 228 \quad \text{(ALUMINUM)}$$

INDUCTION MOTORS

$$n_s = \frac{120F}{P}$$

$$S = \frac{n_s - n}{n_s}$$

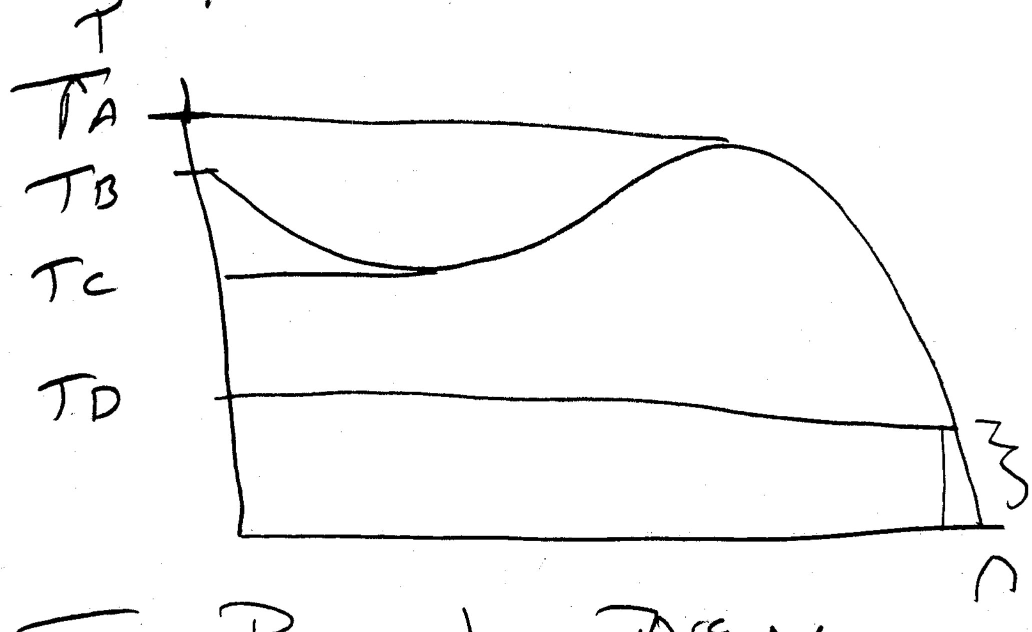
$$n = (1-S)\,n_s$$

if n same direction as n_s
$0 < S < 1$
if n in opposite direction
$S > 1$

$$f_2 = SF \qquad E_2 = S\,E_{oc}$$

$$9.55\,P_m = T * n$$

$$9.55\,P_r = T * n_s$$

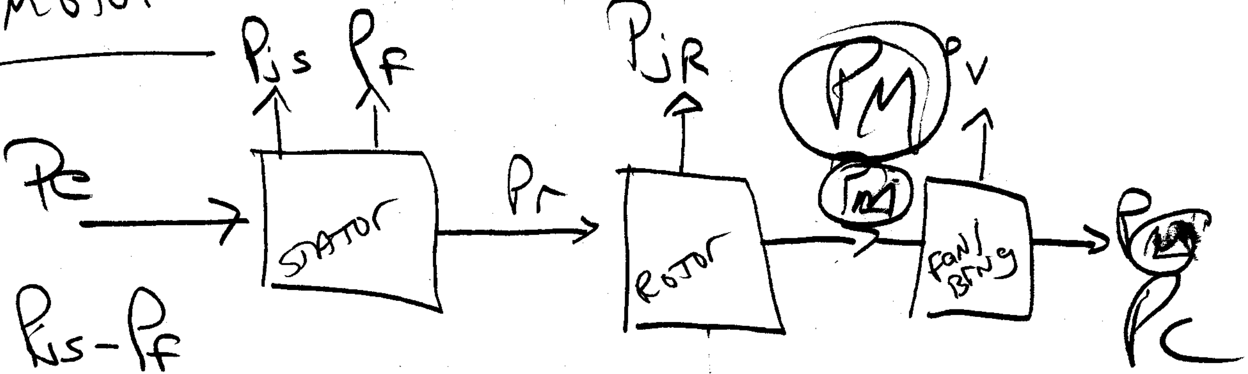


In this Area

T_A = Breakdown Torque
T_B = Locked Rotor Torque
T_C = Pull up Torque
T_D = Full Load Torque

$$\frac{S_2}{S_1} = \frac{T_2}{T_1} \cdot \frac{R_2}{R_1} \cdot \left[\frac{E_1}{E_2}\right]^2$$

MOTOR



$P_r = P_e - P_{js} - P_F$

$P_M = P_r - P_{jR}$

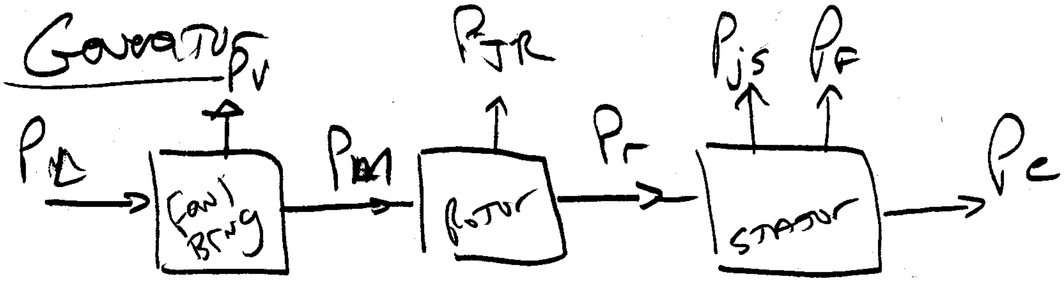
$P_L = P_M - P_v$

$\eta = \frac{P_L}{P_e}$

$P_{jR} = sP_r$

$P_L = (1-s)P_r$

GENERATOR



$P_M = P_L - P_v$

$P_r = P_M - P_{jR}$

$P_e = P_r - P_{js} - P_F$

$\eta = \frac{P_e}{P_L}$

$P_{jR} = sP_r$

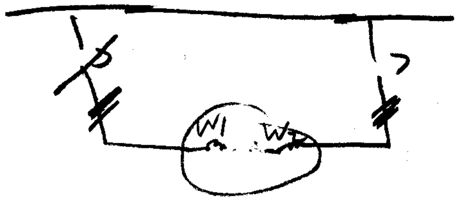
$P_L = P_r + sP_r$

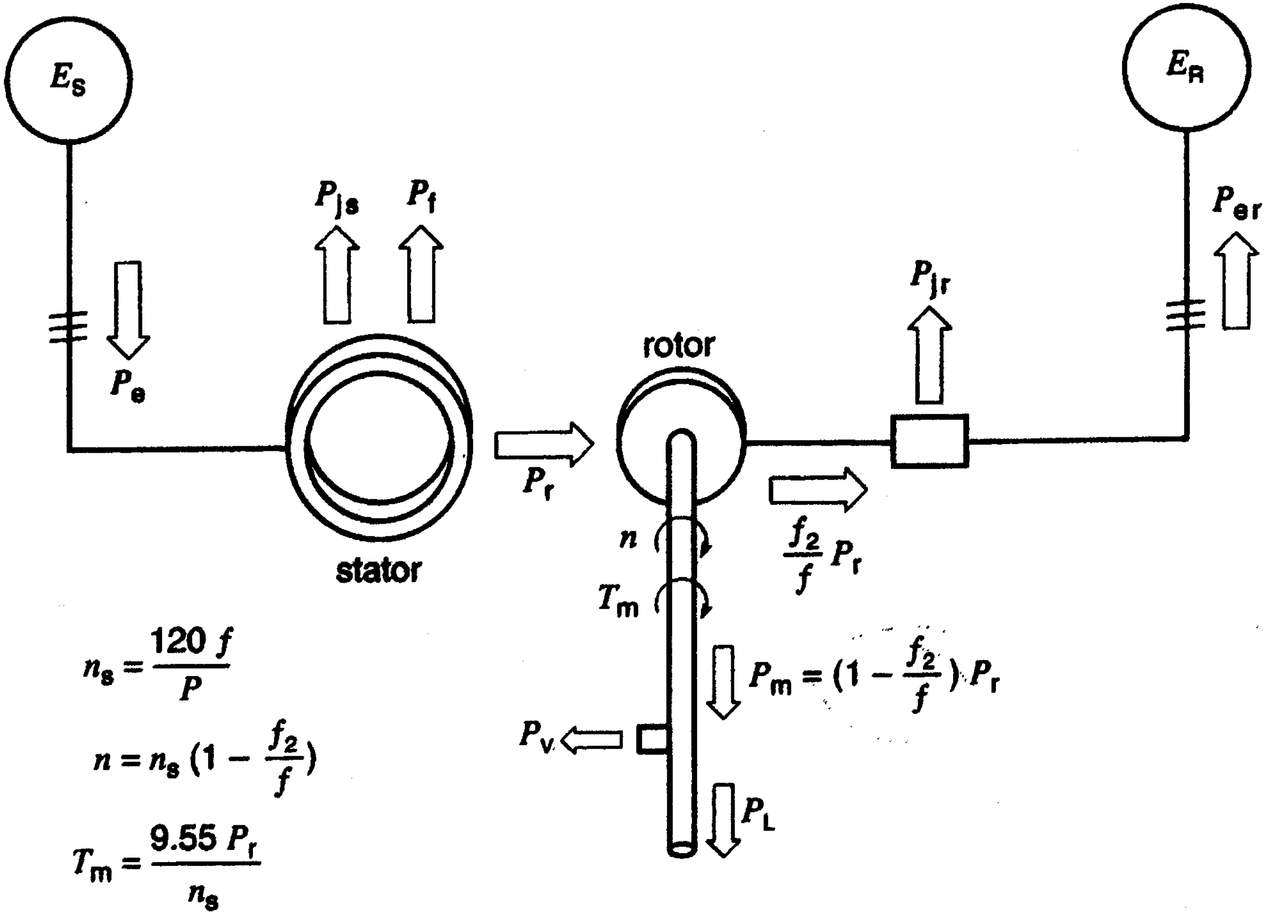
$P_L = (1+s)P_r$

Doubley-Fed Machines

Use figure Based on ① Motor or generator
② subsynchronous or Super synchronous

SAFEy → Two winding motor when driven from one winding Energizes other winding





$$n_s = \frac{120\,f}{P}$$

$$n = n_s\,(1 - \frac{f_2}{f})$$

$$T_m = \frac{9.55\,P_r}{n_s}$$

Figure 13.35
Power flow in a doubly-fed wound-rotor induction motor in subsynchronous mode.

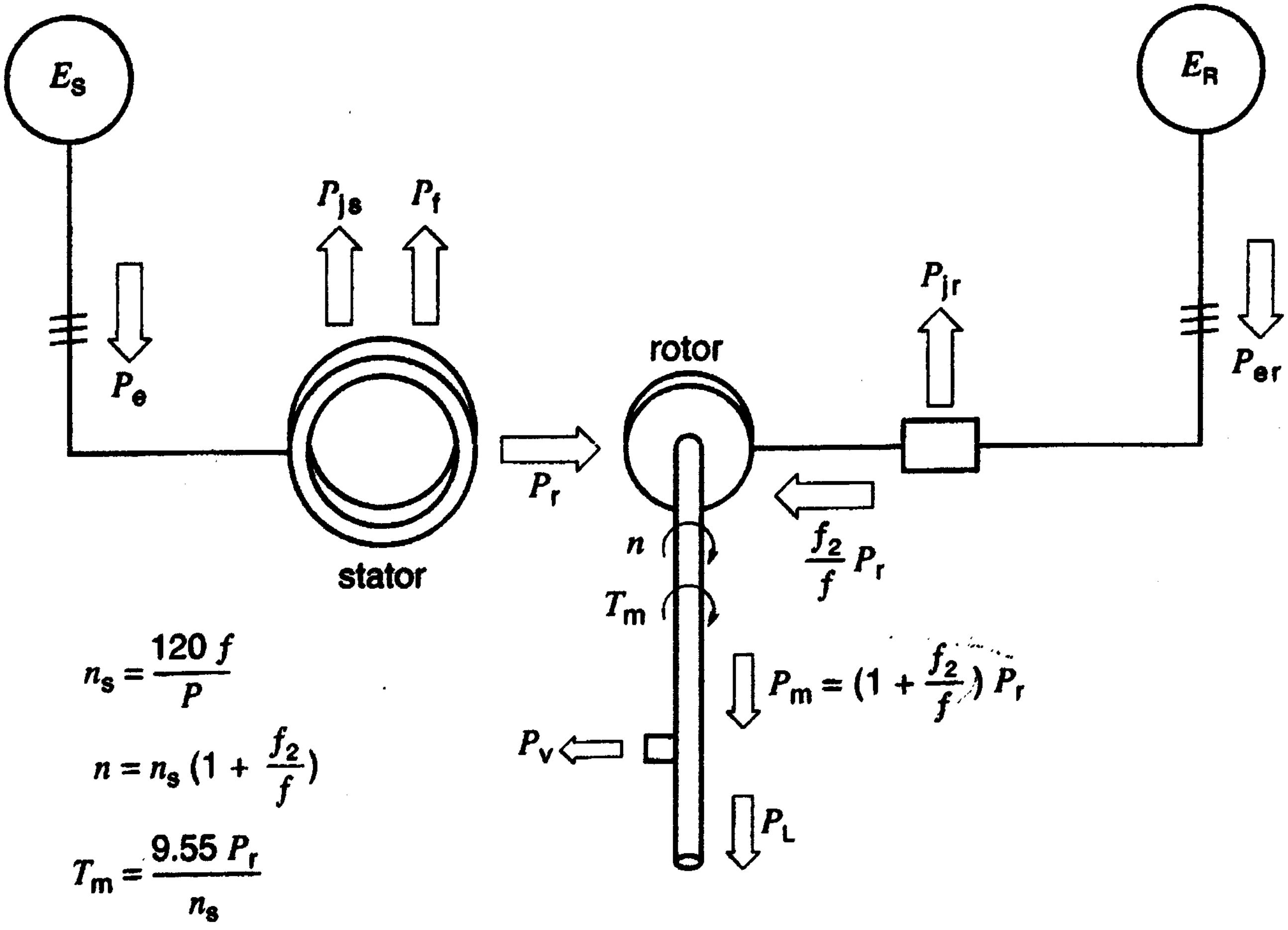
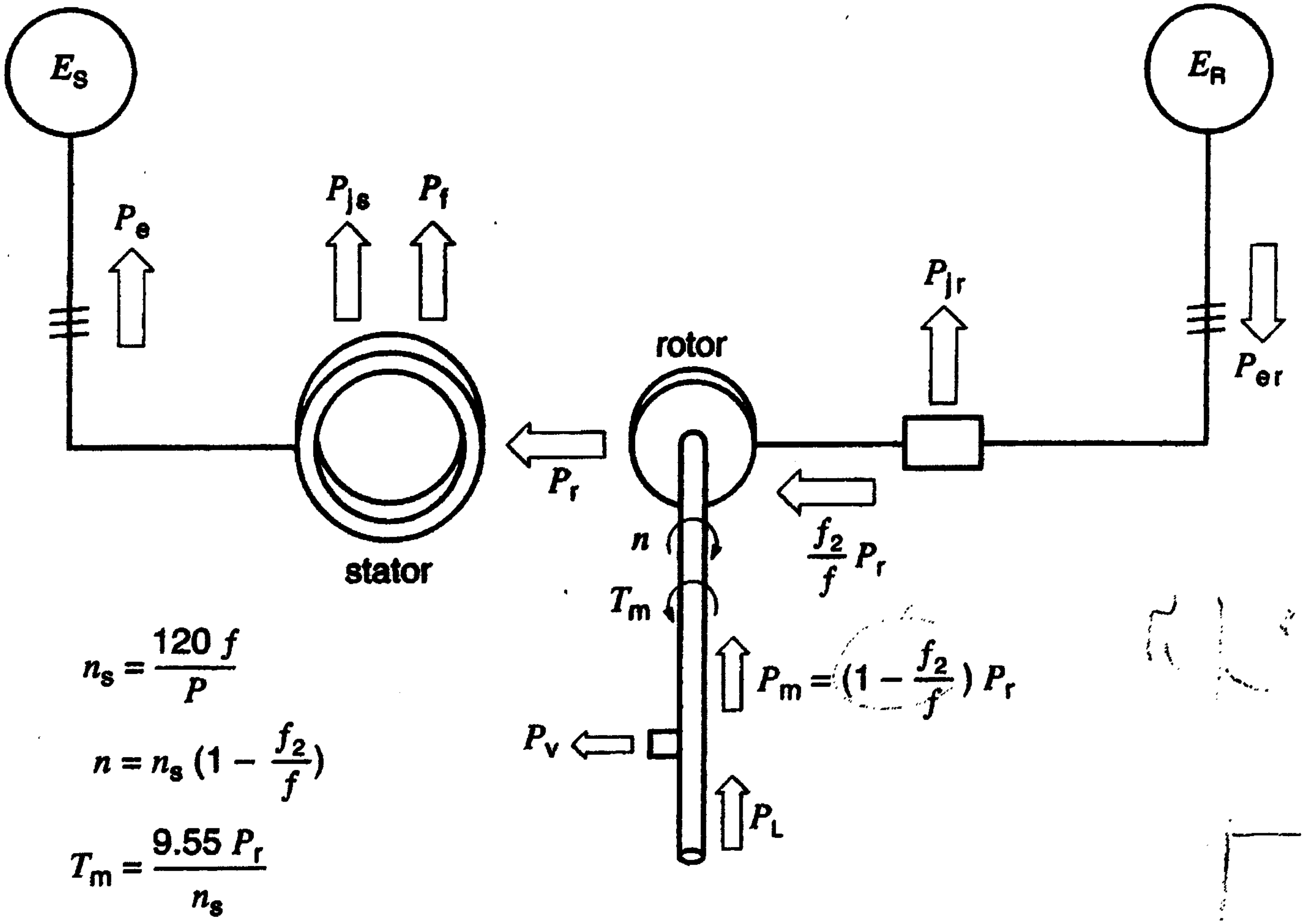


Figure 13.36
Power flow in a doubly-fed wound-rotor induction motor in supersynchronous mode.



$$n_s = \frac{120\,f}{P}$$

$$n = n_s\,(1 - \frac{f_2}{f})$$

$$T_m = \frac{9.55\,P_r}{n_s}$$

Figure 13.37
Power flow in a doubly-fed wound-rotor induction generator in subsynchronous mode.

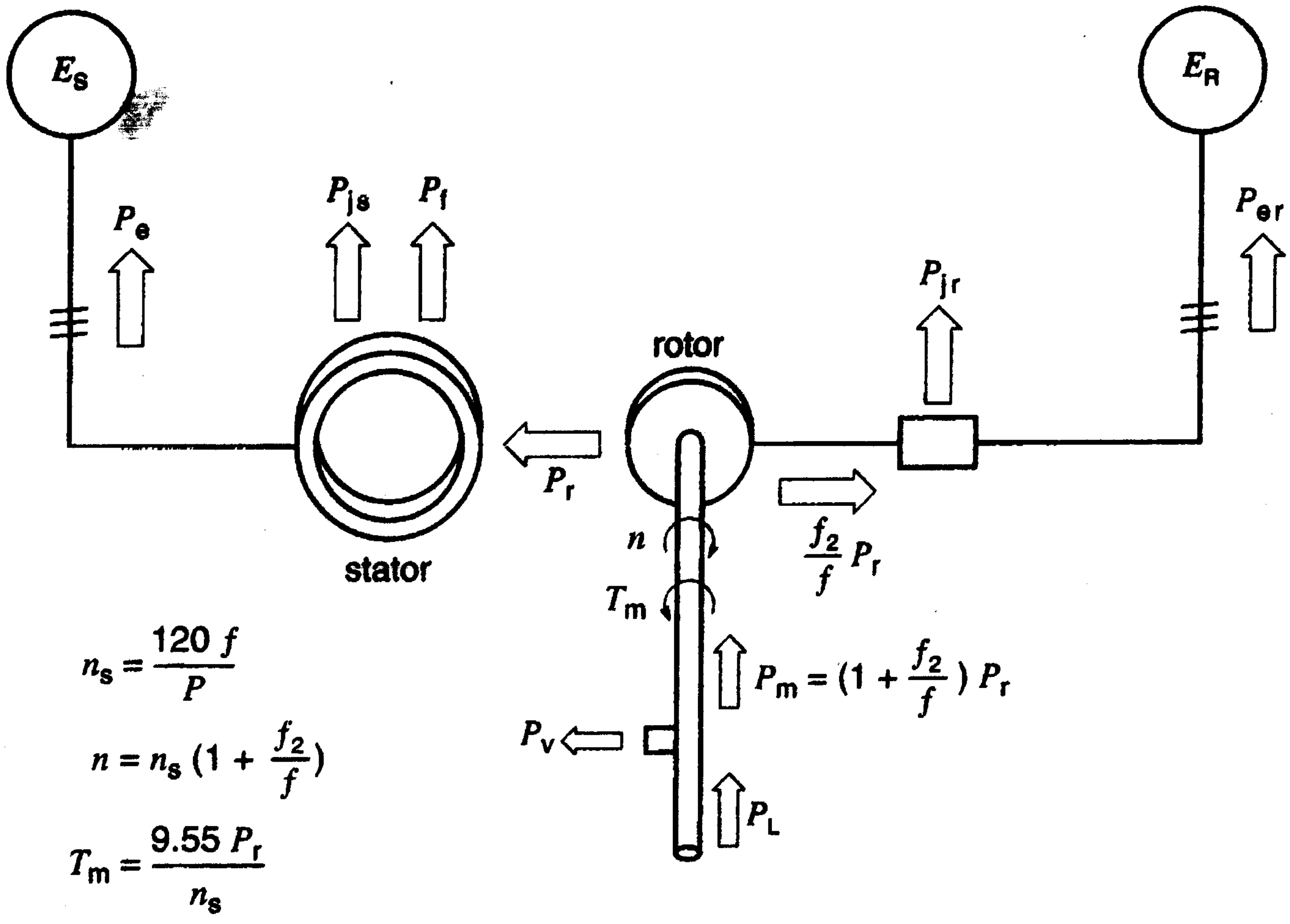


Figure 13.38
Power flow in a doubly-fed wound-rotor induction generator in supersynchronous mode.