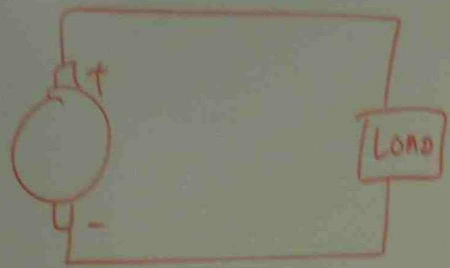
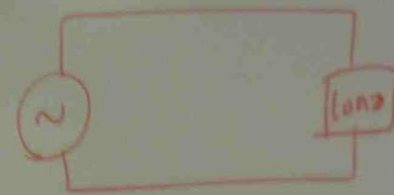
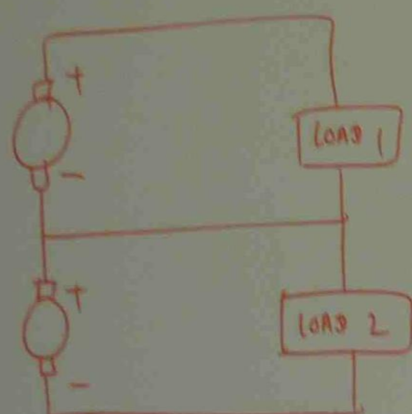
COMPARING POWER SYSTEMS



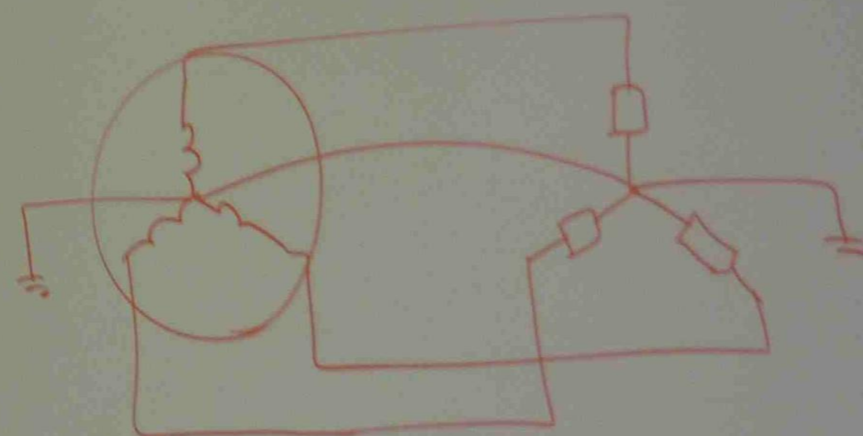
2WIRES DC SYSTEM



1ϕ AC SYSTEM

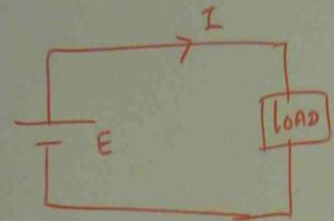


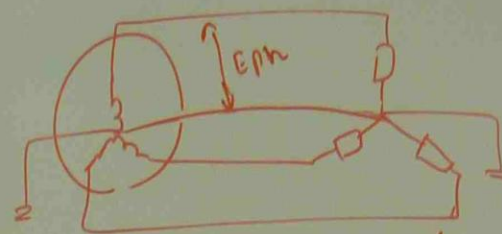
3WIRES DC SYSTEM



3ϕ AC SYSTEM

P) COMPARE THE COPPER WEIGHT OF 3ϕ 3WIRES SYSTEM AND SIMPLE DC SYSTEM.





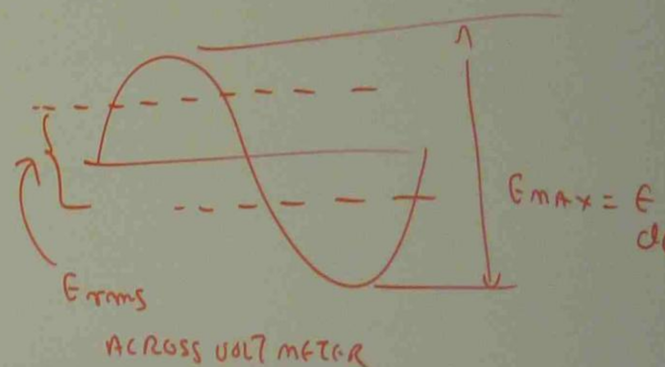
SIMPLE DC SYSTEM

DC POWER = $E \times I$ $\qquad$ 3ϕ AC POWER = $3\, E_{ph}\, I' \cos\theta$

ASSUMPTION(1) $\quad$ SAME POWER IS PRODUCED.

DC POWER = 3ϕ AC POWER

$$E \times I = 3\, E_{ph}\, I' \cos\theta$$



ASSUMPTION(2)

SAME VOLTAGE LEVEL $\qquad E_{ph} = \dfrac{E_{MAX}}{\sqrt{2}}$ (RMS)

$\therefore E = E_{MAX}$

$$\cancel{E} \times I = 3\, \frac{\cancel{E_{MAX}}}{\sqrt{2}}\, I' \cos\theta \longrightarrow I = \frac{3 I' \cos\theta}{\sqrt{2}} \quad \text{— (1)}$$

ASSUMPTION (3)

POWER LOSSES ARE TO BE COMPARED

DC POWER LOSS : 3ϕ AC POWER LOSS

$$2 I^2 R_1 : 3(I')^2 R_2$$

$$2\left(\frac{3 I' \cos\theta}{\sqrt{2}}\right)^2 R_1 : 3(I')^2 R_2$$

$$2 \times \frac{9 (I')^2 \cos^2\theta}{2} R_1 : 3(I')^2 R_2$$

$$9 \cos^2\theta R_1 : 3 R_2$$

$$3\cos^2\theta R_1 : R_2$$

$$3\cos^2\theta \frac{\rho L}{A_1} : \frac{\rho L}{A_2}$$

$$R = \frac{\rho L}{A}$$

ρ = RESISTIVITY

L = LENGTH

A = CROSS SECTIONAL AREA (C.S.A)

SAME LENGTH L

SAME MATERIAL ρ

$$\frac{3\cos^2\theta}{\text{DC CSA}} : \frac{1}{\text{AC CSA}}$$

$$\frac{\text{DC CSA}}{3\cos^2\theta} : \text{AC CSA}$$

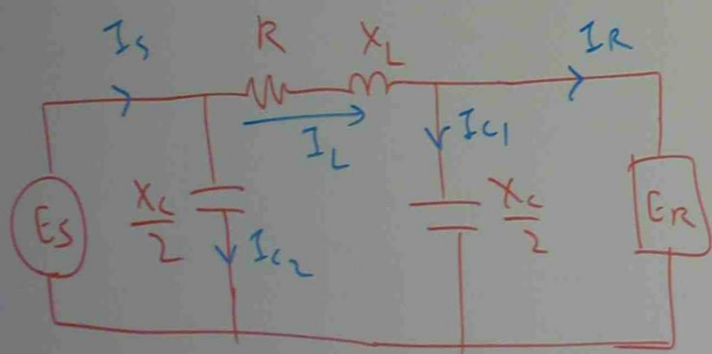
$$\frac{1}{3\cos^2\theta} : \frac{\text{AC CSA}}{\text{DC CSA}}$$

$$\frac{\text{AC } 3\phi \text{ LINE C.SA}}{\text{DC LINE C.SA}} : \frac{1}{3(\text{POWER FACTOR})^2}$$

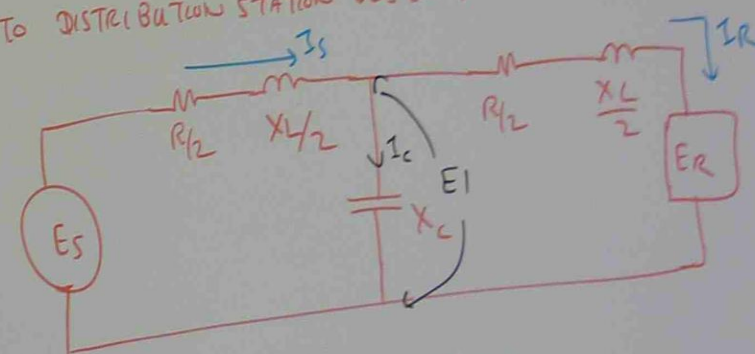
VOLTAGE VARIATIONS IN POWER SYSTEM

LINE RESISTANCE AND LINE INDUCTIVE REACTANCE CAUSE VOLTAGE DROP AND VARIATION OF LINE VOLTAGE.

TO COMPENSATE LINE VOLTAGE DROP,
(1) USE HIGH VOLTAGE TRANSMISSION SYSTEM
(2) USE TAP CHANGER (OR) VOLTAGE REGULATOR
(3) USE POWER FACTOR IMPROVEMENT SYSTEM
(FREE RUNNING SYNCHRONOUS MOTOR CONNECTED TO DISTRIBUTION STATION BUS BAR)

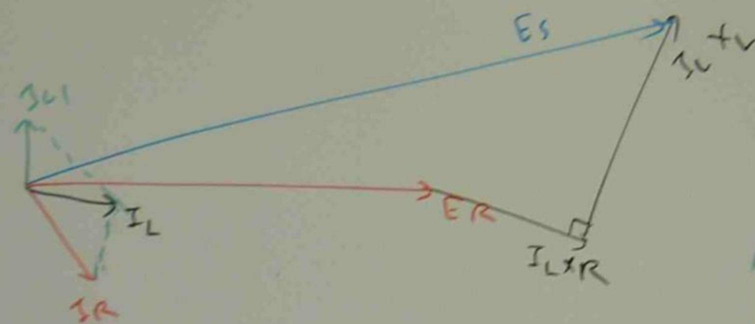


π EQUIVALENT CIRCUIT

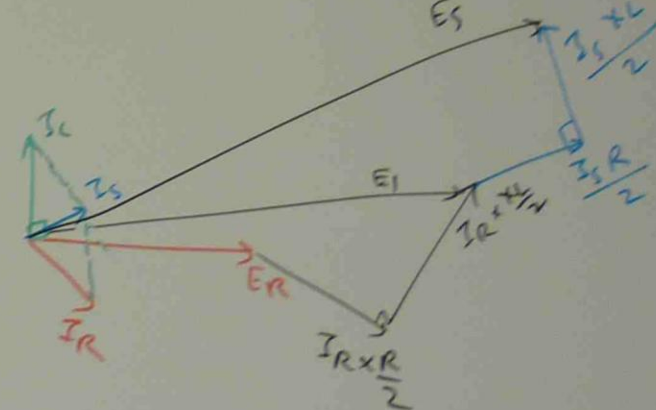


T EQUIVALENT CIRCUIT

Π EQUIVALENT VECTOR DIAGRAM



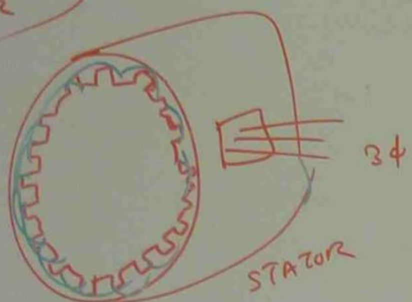
T EQUIVALENT CIRCUIT VECTOR DIAGRAM

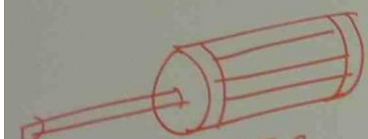


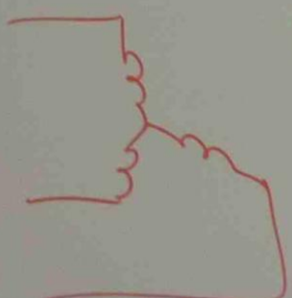
BY STUDYING THE VECTOR DIAGRAMS, THE COMPONENT THAT EFFECTS THE LINE VOLTAGE VARIATIONS CAN BE IDENTIFIED.

TAP CHANGER — ON LOAD
└ OFF LOAD

INDUCTION MOTOR



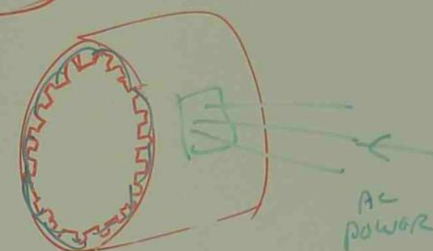


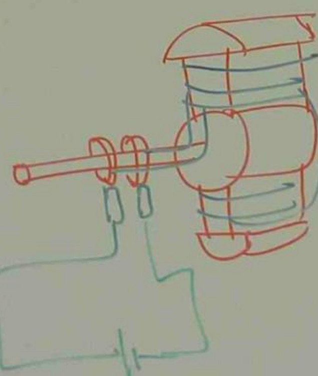


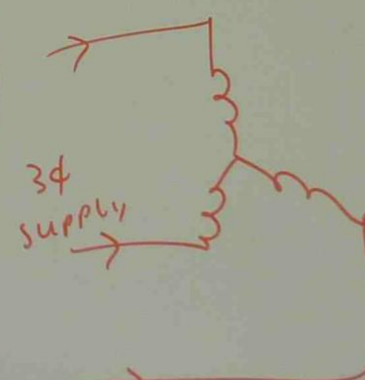
STATOR

LAGGING P.F

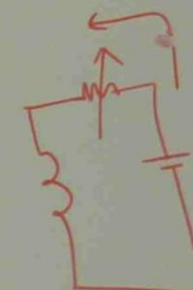
SYNCHRONOUS MOTOR







I_{dc} = FIELD EXCITATION CURRENT



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COMPONENTS OF CIRCUIT BREAKER

ANTI PUMPING DEVICE

A DEVICE WHICH PREVENTS THE CIRCUIT BREAKER RECLOSING AFTER OPENING

SHUNT TRIP

A TRIP RELEASE ENERGIZED BY A SOURCE OF VOLTAGE WHICH MAY NOT BE DEPENDENT ON MAIN CIRCUIT VOLTAGE

RELEASE

A DEVICE MECHANICALLY CONNECTED TO THE CIRCUIT WHICH RELEASES THE HOLDING.