SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 23EET204/ ELECTRICAL MACHINES II

II YEAR / IV SEMESTER

Unit 1 – SYNCHRONOUS GENERATOR

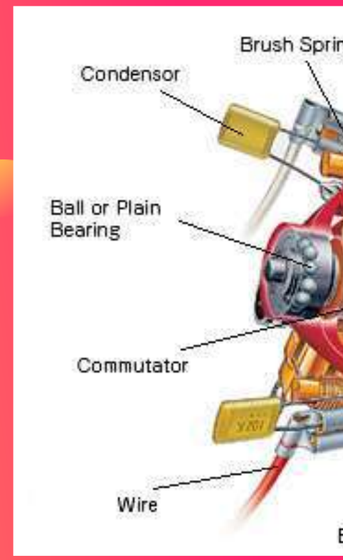
Topic 4,5,6: Synchronous reactance Armature reaction – Phasor diagrams

Causes of Voltage drop in Alternator

Armature Effective Resistance (R_{eff})

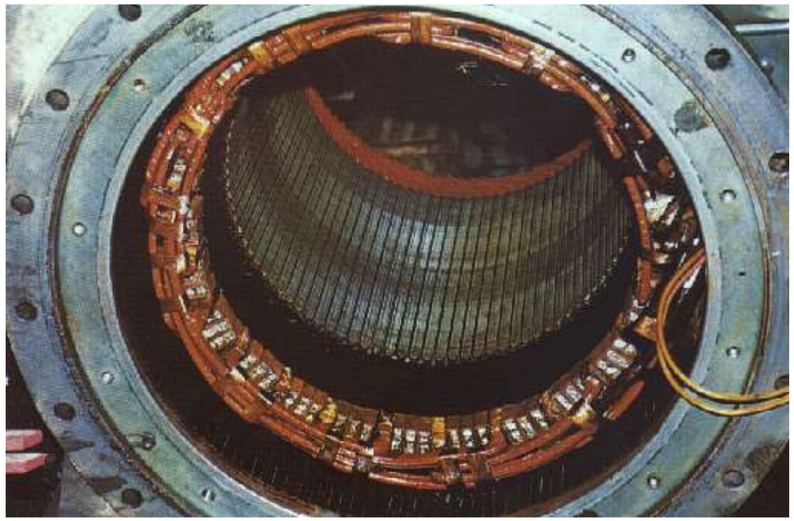
Armature Leakage Reactance (X_L)

Armature Reactance



Armature Leakage Reactance(XL)

Armature Leakage Reactance(XL)



Three major components -Slot leakage reactance, end winding leakage reactance and tooth tip leakage reactance.

Synchronous reactance / phase

$Xs = X_L + Xa$

where

Xa is the fictitious armature reaction reactance.

Synchronous impedance/phase

$Zs = (Ra + jXs)$

Synchronous Reactance

- The value of X_S can be determined by measurements of the open-circuit and short-circuit tests
  - Test are conducted under an unsaturated core condition
  - Open-circuit test is conducted at rated speed with the exciting current I_{xn} adjusted until the generator terminals are at rated voltage, E_n
  - Short-circuit test is conducted at rated speed with the exciting current I_{xn} gradually raised from 0 amps up to the original value used in the open-circuit test
  - The resulting short-circuit current Isc is measured, allowing the calculation of X_S

$$X_S = E_n / I_{SC}$$

Where:

X_S = Synchronous reactance per phase[Ω]

E_n = Rated open circuit voltage line to neutral [V]

I_{SC} = Short-circuit current, per phase, using same exciting current Ixn that was required to produce En [A]

Armature Reaction

Effect of the armature flux on the main field flux.

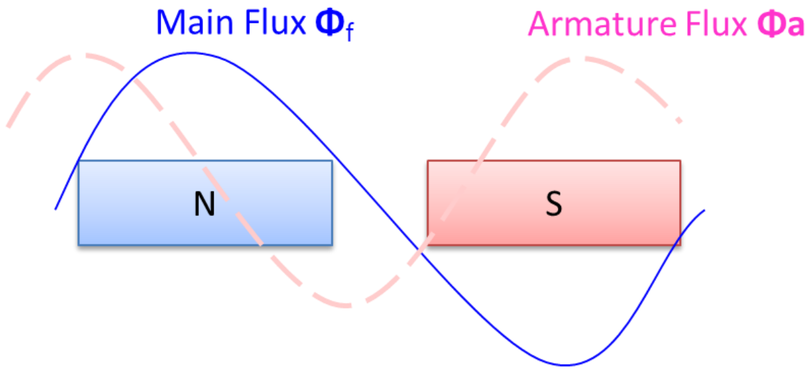
Armature Reaction effect depends upon the PF of the Load

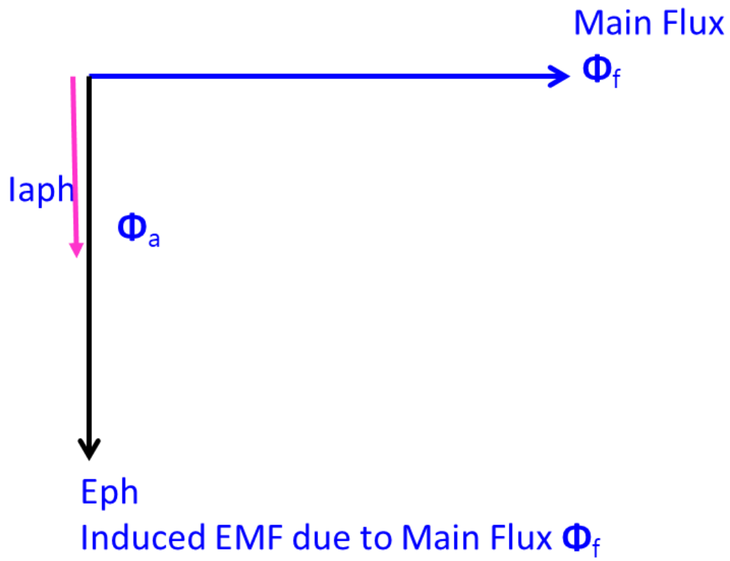
UPF - cross magnetizing.
Lag PF - demagnetizing.
Lead PF - magnetizing

UPF(Pure Resistive Load)-cross magnetizing

UPF (Pure Resistive Load)

cross magnetizing

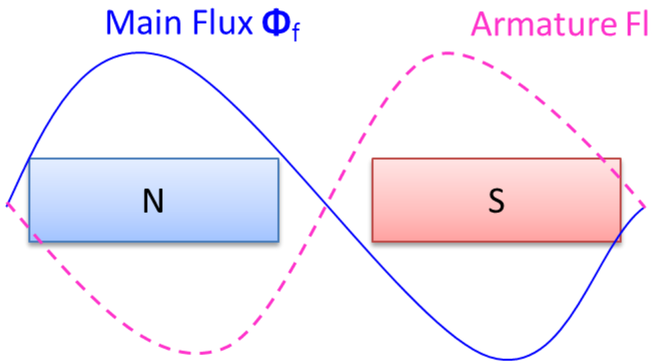


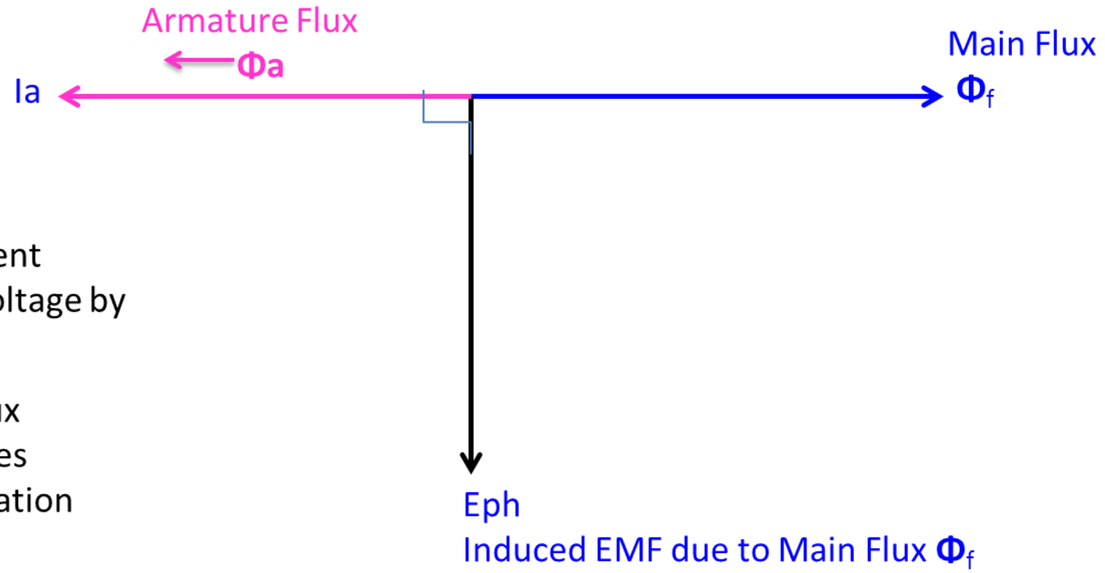


Lagging PF(Purely Inductive Load) Demagnetizing

Lagging PF (Purely Inductive Load)

Demagnetizing





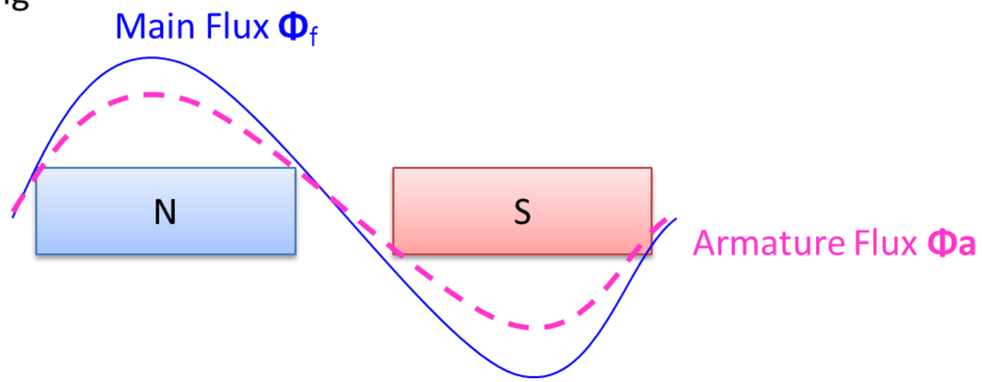
Load current
Lag the Voltage by
90

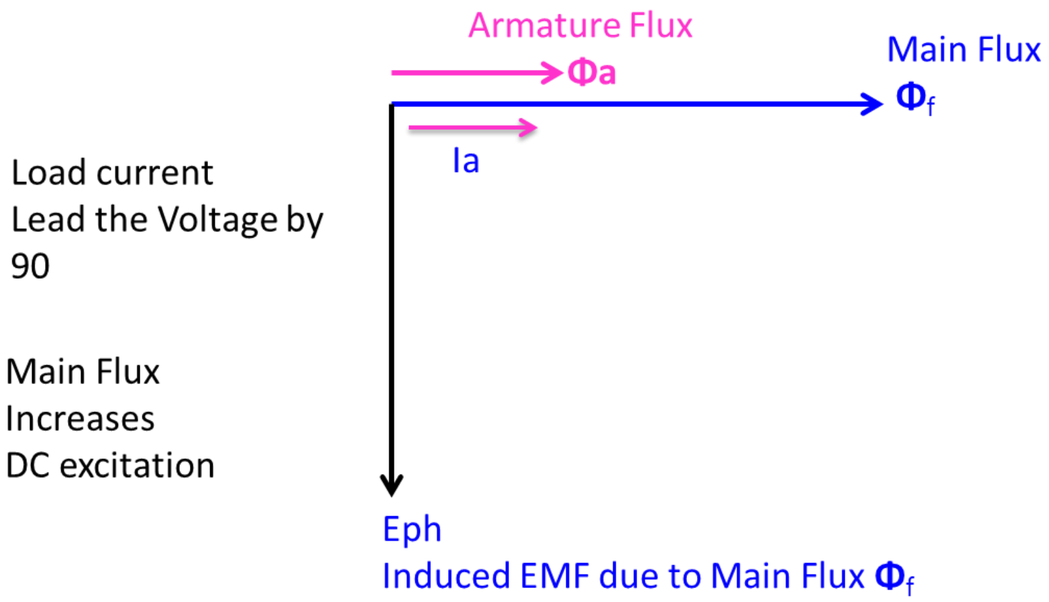
Main Flux
Decreases
DC excitation

Lead PF (Purely Capacitive Load) Magnetizing

Lead PF (Purely Capacitive Load)

Magnetizing





KEEP
LEARNING..

Thank u

SEE YOU IN NEXT CLASS