LECTURE 3

Operation Principle

The rotor of the generator is driven by a prime-mover

A dc current is flowing in the rotor winding which produces a rotating magnetic field within the machine

The rotating magnetic field induces a three-phase voltage in the stator winding of the generator

The Rotating Magnetic Field

Principle of Machine Operation:

•**If a three-phase set of currents, each with equal magnitude and differing in phase by 120 degrees, flows in an armature winding, then it will produce a rotating magnetic field of <u>constant magnitude.</u>**

The flux wave will travel in the air gap at the speed of $n_{sync} = \dfrac{120 f_e}{P}$ **where f_e is the frequency of the three phase currents.**
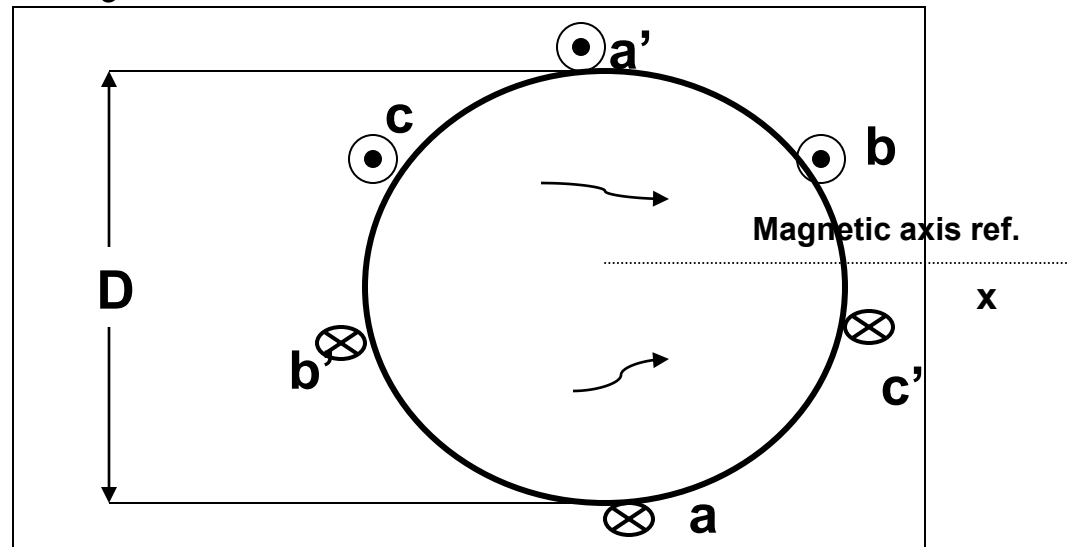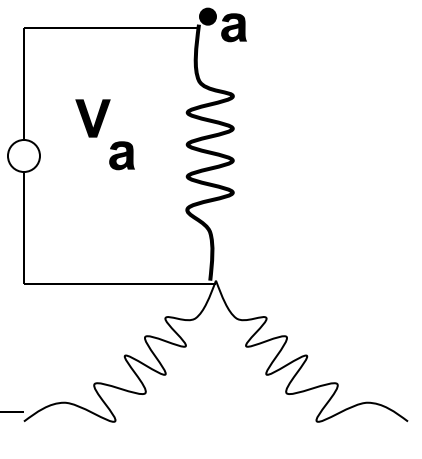
Electrical Frequency

Electrical frequency produced is locked or synchronized to the mechanical speed of rotation of a synchronous generator:

$$f_e = \frac{P\,n_m}{120}$$

where f_e **= electrical frequency in Hz**

P **= number of poles**

n_m **= mechanical speed of the rotor, in r/min**

Machine Eq. CKT

V_T

R_a

jX_s

E_a

E_c

R_a

jX_s

E_b

R_a

jX_s

b

c

V_f

I_f

$E \quad R_a \quad + jX_s \quad V_T$

$E \rightarrow \text{line - line}$

$V_t \rightarrow \text{line - line}$

$X_s \rightarrow \text{synch. reactance}$

$R_a \rightarrow \text{armature resistance}$