



# **SNS COLLEGE OF ENGINEERING**

Kurumbapalayam (Po), Coimbatore – 641 107

**An Autonomous Institution**

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade

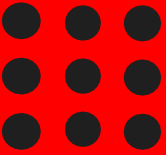
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## **DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**COURSE NAME : 19EE401 SYNCHRONOUS AND INDUCTION MACHINES**

**II YEAR /IV SEMESTER**

**UNIT – I SYNCHRONOUS GENERATOR**





# Frequency & Poles

Let

$N$  = rotor speed in r.p.m.

$P$  = number of rotor poles

$f$  = frequency of e.m.f. in Hz

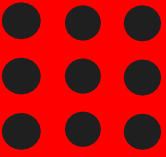
$\therefore$  No. of cycles/revolution = No. of pairs of poles =  $P/2$

No. of revolutions/second =  $N/60$

$\therefore$  No. of cycles/second =  $(P/2)(N/60) = NP/120$

But number of cycles of e.m.f. per second is its frequency.

$$\therefore f = \frac{NP}{120}$$





# EMF Equation of an Alternator

## E.M.F. Equation of an Alternator

Let  $Z$  = No. of conductors or coil sides in series per phase  
 $\phi$  = Flux per pole in webers  
 $P$  = Number of rotor poles  
 $N$  = Rotor speed in r.p.m.

In one revolution (i.e.,  $60/N$  second), each stator conductor is cut by  $P\phi$  webers  
i.e.,

$$d\phi = P\phi; \quad dt = 60/N$$

$\therefore$  Average e.m.f. induced in one stator conductor

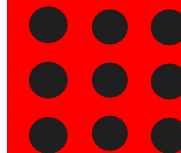
$$= \frac{d\phi}{dt} = \frac{P\phi}{60/N} = \frac{P\phi N}{60} \text{ volts}$$

Since there are  $Z$  conductors in series per phase,

$$\begin{aligned} \therefore \text{Average e.m.f./phase} &= \frac{P\phi N}{60} \times Z \\ &= \frac{P\phi Z}{60} \times \frac{120 f}{P} && \left( \because N = \frac{120 f}{P} \right) \\ &= 2f\phi Z \text{ volts} \end{aligned}$$

R.M.S. value of e.m.f./phase = Average value/phase x form factor  
 $= 2f\phi Z \times 1.11 = 2.22 f\phi Z$  volts

$$\therefore E_{\text{r.m.s.}} / \text{phase} = 2.22 f\phi Z \text{ volts} \quad (i)$$





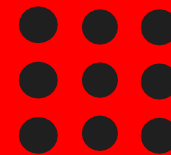
If  $K_p$  and  $K_d$  are the pitch factor and distribution factor of the armature winding, then,

$$E_{r.m.s.}/\text{phase} = 2.22K_pK_d f\phi Z \text{ volts} \quad (\text{ii})$$

Sometimes the turns (T) per phase rather than conductors per phase are specified, in that case, eq. (ii) becomes:

$$E_{r.m.s.}/\text{phase} = 4.44K_pK_d f\phi T \text{ volts} \quad (\text{iii})$$

The line voltage will depend upon whether the winding is star or delta connected.





# REFERENCES

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- Fitzgerald, A.E., Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata McGraw Hill Publishing Company Limited, 2013.
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## THANK YOU