SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

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 : 19EE401 SYNCHRONOUS AND INDUCTION MACHINES

II YEAR /IV SEMESTER

UNIT – I SYNCHRONOUS GENERATOR

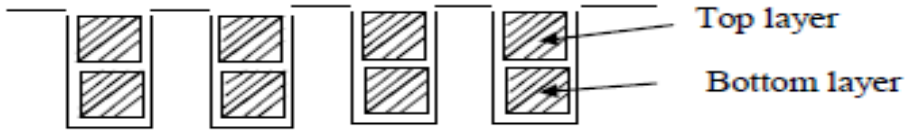
Armature Windings

- Armature winding in an alternator open type. One end of the winding connected to neutral point (star connection) other brought out.
- Types
  - Single layer winding
  - Double layer winding.

Single Layer Winding

- One Coil-side occupies the total slot area
- Used only in small AC machines

one coil-side per slot



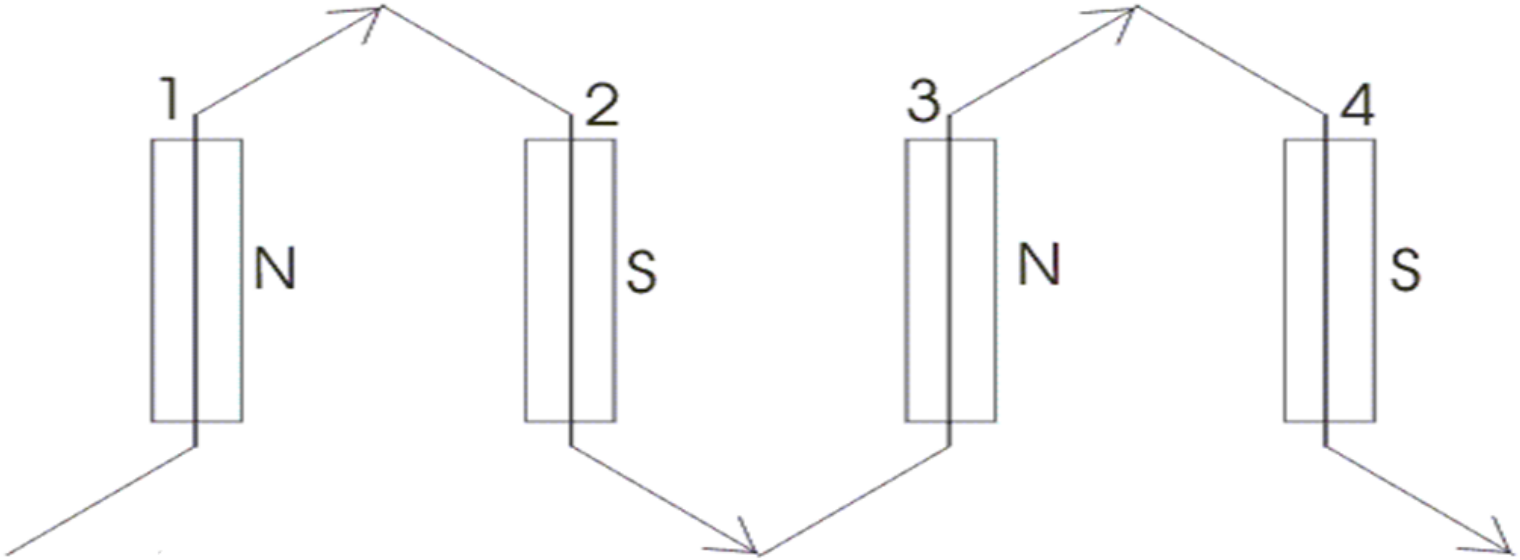
Two coil –sides per slot

Double Layer Winding

- Slot contains even number of coil sides in two layers.
- Double layer winding is more common above 5kW machine

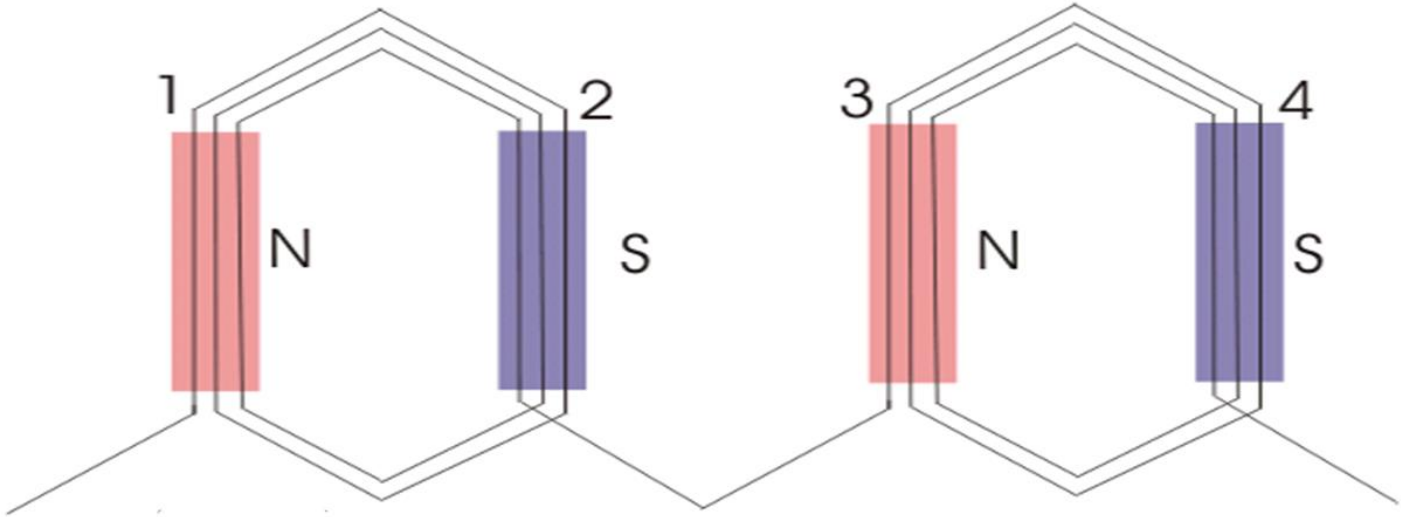
Concentric Winding

- All the winding turns are wound together in series to form one multi-turn coil
- All the turns have the same magnetic axis
- number poles = number of slots = number of coil sides.
- Here, one coil side is inside one slot under one pole and other coil side inside other slot under next pole. Clearly the emf induced in one coil side is added to that of adjacent coil side.



Distributed Winding

- For obtaining smooth sinusoidal emf wave from, conductors are placed is several slots under single pole. This armature winding is known as distributed winding.
- All the winding turns are arranged in several full-pitch or fractional-pitch coils
- These coils are then housed in the slots spread around the air-gap periphery to form phase or commutator winding

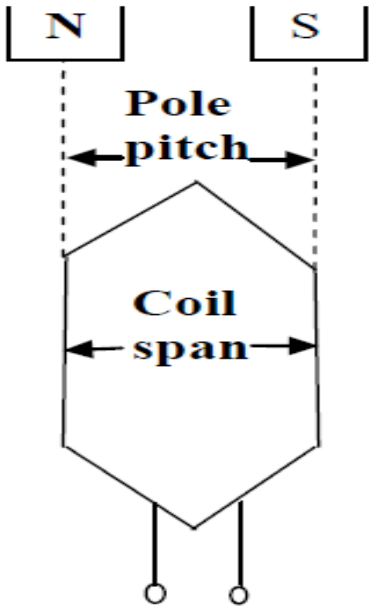


Fractional Slot Winding

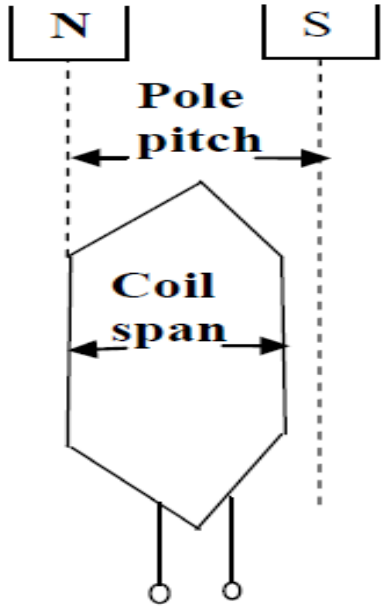
- When the number of slots per pole per phase is an integer, the winding is the integer slot winding but when the number slots per pole per phase is fractional number the winding is referred as fractional slot winding.
- Fractional slot winding is practicable only with double layered winding.
- It limits the number of parallel circuit available, because phase group under several poles must be connected in series before a unit is formed and the widening respects the pattern to give second unit that can be put in parallel with the first.

Short Pitch Winding

- When the coil span or coil pitch is equal to the pole pitch, it is termed as full pitch coil. In case, the coil pitch is less than pole pitch, then it is called as short pitch winding



Full-pitch coil

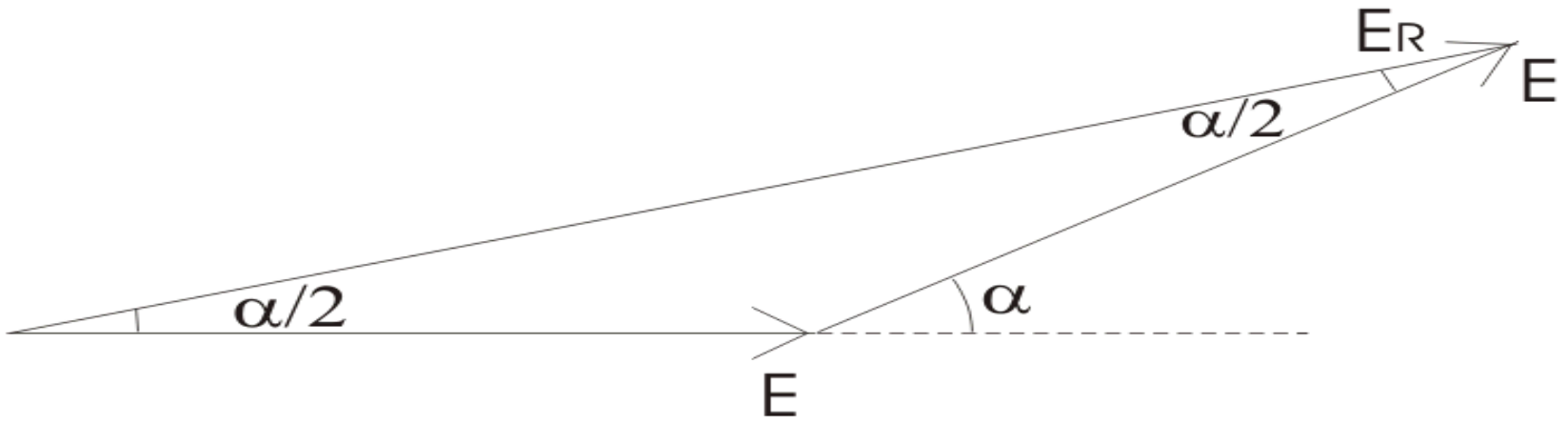


Short-pitched or chorded coil

Pitch Factor

- The ratio of phasor sum of induced emfs per coil to the arithmetic sum of induced emfs per coil is known as pitch factor ($\mathbf{K_p}$).

$$K_p = \frac{\textbf{Phasor Sum of Coil side emfs}}{\textbf{Arithmetic Sum of Coil side emfs}} \Rightarrow K_p = \frac{2E\cos\frac{\alpha}{2}}{2E} = \cos\frac{\alpha}{2}$$



Distribution Factor

$$K_d = \frac{EMF\ induced\ in\ distributed\ winding}{EMF\ induced\ if\ the\ winding\ would\ have\ been\ Concentrated}$$

$$= \frac{Phasor\ sum\ of\ component\ emfs}{Arithmetic\ sum\ of\ component\ emfs}$$

$$\beta = \frac{180^\circ}{\text{No. of slots/pole}} = \frac{180^\circ}{n}$$

m = No. of slots/phase/pole

$m\beta$ = phase spread angle

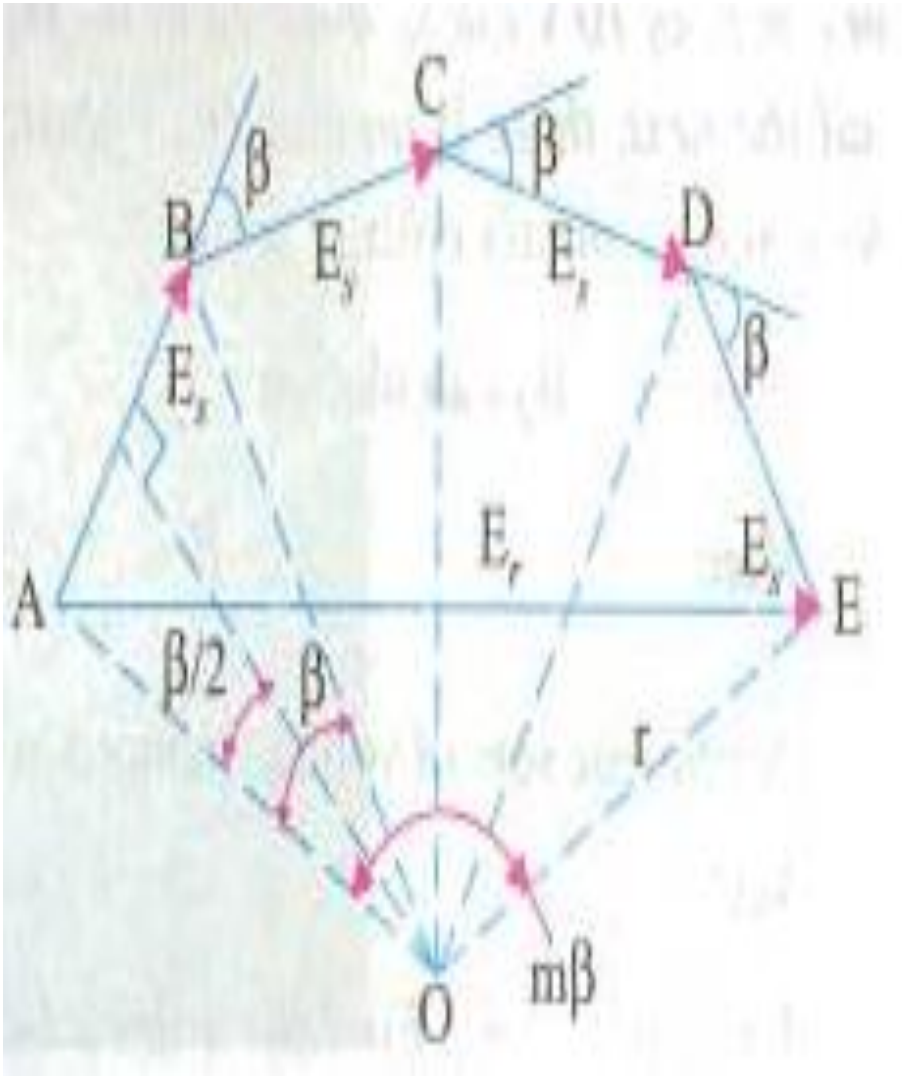
$$AB = E_S = 2r \sin \beta/2$$

Arithmetic sum is $= mE_S = m \times 2r \sin \beta/2$

Their vector sum $= AE = E_r = 2r \sin m\beta/2$

$$k_d = \frac{\text{vector sum of coils e.m.fs.}}{\text{arithmetic sum of coil e.m.fs.}}$$

$$= \frac{2r \sin m\beta/2}{m \times 2r \sin \beta/2} = \frac{\sin m\beta/2}{m \sin \beta/2}$$



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THANK YOU