4.7 EMF EQUATION OF PRACTICAL BLPM SINE WAVE MOTOR

In a practical BLPM sine wave motor at the time of design it is taken care to have the flux density is sinusoidal distributed and rotor rotates with uniform angular velocity. However armature winding consists of short chorded coils properly distributed over a set of slot. These aspects reduce the magnitude of E_{ph} of an ideal winding by a factor K_{w1} which is known as the winding factor the fundamental component of flux.

$$e = -N\, d\phi/dt$$

$$-d\phi/dt \quad \text{as } N=1$$

$$= -d\phi/dt \; ((2B\square\, lr/p) \cos p\theta\, \omega_{mt})$$

$$= (2B\square\, lr/p)\, p\, \omega_m \sin p\, \omega_{mt}$$

$$e = 2B\square\, lr\, \omega_m \sin p\, \omega_{mt} \qquad \text{.......(5.2)}$$

$$K_{w1} = K_{s1} K_{p1} K_{b1} \qquad \text{.......(5.8)}$$

K_{s1} =slew factor

$K_{s1} = (\sin \sigma/2)/(\sigma/2)$

$K_{s1} = 1$ (slightly less than 1)

σ – Skew angle in elec. Radians.

K_{p1} = pitch factor (or) short chording factor

$= \sin m\pi/2$ or $\cos \rho/2$

Where m = coil span/pole pitch

= fraction < 1

$\pi(1 - m) = \rho$

[Coil span = τ

= π elec rad

= π/ρ mech. Rad]

K_{p1}=sin $\frac{m\pi}{2}$ or cos $\frac{\rho}{2}$

[mπ *is elec rad* $\frac{m\pi}{p}$ mech. Rad.]

K_{b1} = Distribution factor or width factor

$$K_{b1} = \frac{\sin q\frac{v}{2}}{q \sin\frac{v}{2}}$$

Where v = slot angle in elec. Radians

$= \frac{2\pi\rho}{n_s}$; n_s = no. of slots (total)

q = slots/pole/phase for 60° phase spread

= slots/pair of poles/phase

$K_{b1} < 1$; $K_{p1} < 1$; $K_{s1} < 1$

Therefore $K_{w1} = K_{p1} K_{b1} K_{s1} < 1$ (winding factor)

Thus rms value of the per phase emf is

$E_{ph} = 4.44 f \emptyset_m T_{ph} K_{w1}$ volts.