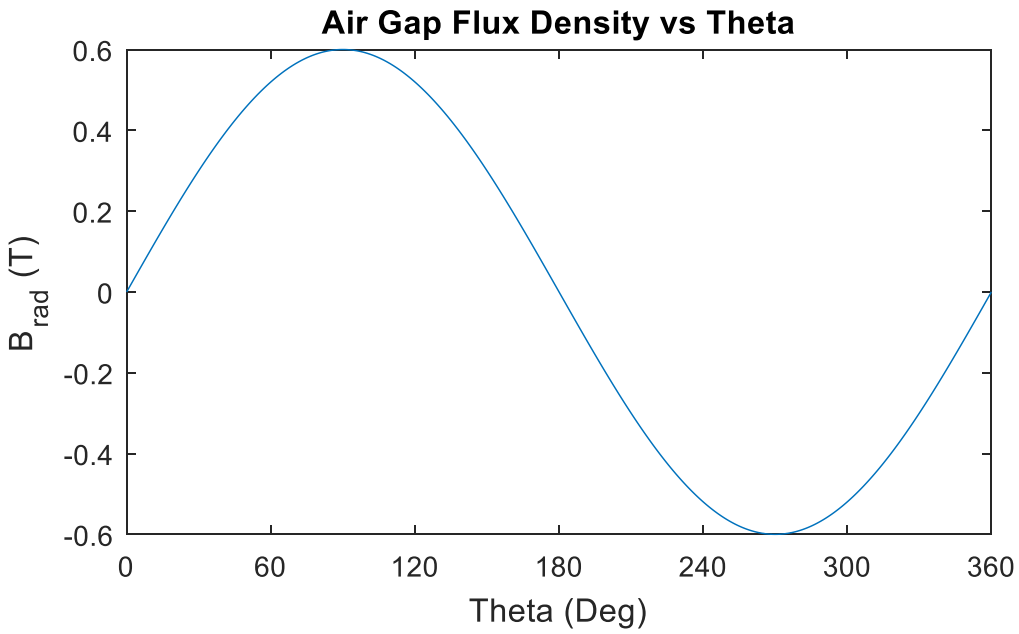
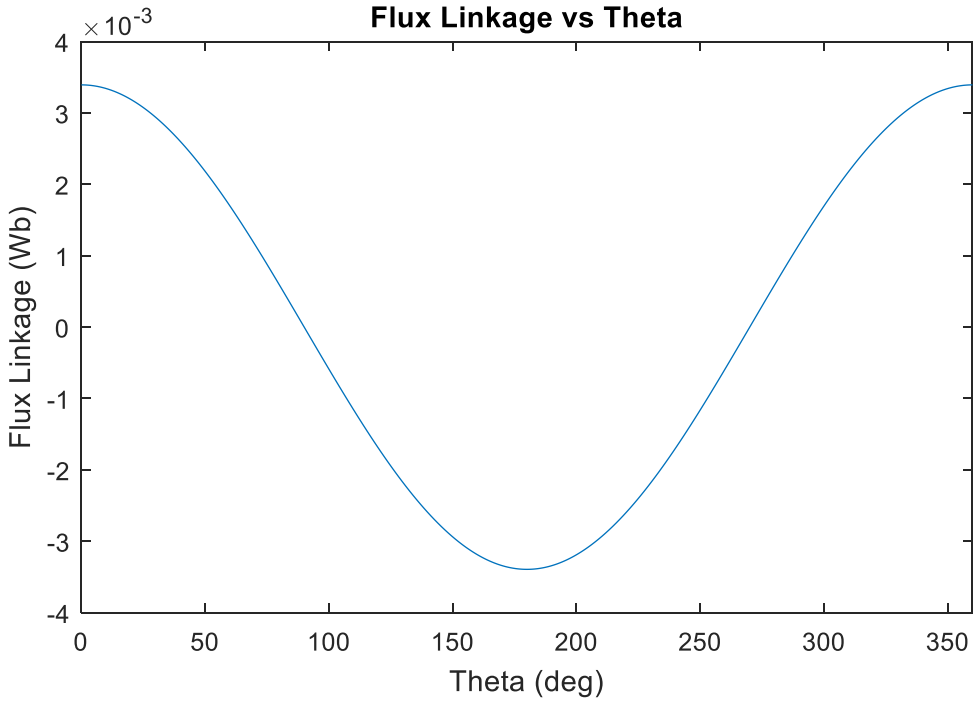
Mehmet Kaan Mutlu

Motor Design Assigment-5

- Winding Design –



$$\lambda = \int_0^l \int_0^\pi \hat{B}\ sin(\theta)\ r\ d\theta\ dl$$



$$e = -\frac{d\lambda}{dt}$$

$$e_{RMS} = 4.44 f N \phi_{max}$$

$$\frac{24}{\sqrt{3}} = 4.44x25xNx0.0034$$

Therefore **N is calculated as 36**.

For each winding, we have 60° area in the air gap. This area corresponds to 75.4 mm^2 and that means (after considering the fill factor) its 52.7 mm^2 can be used for conductors.

If we also take number of turns into account, then each cable thickness becomes 1.46 mm^2. So we can use **3 AWG20** cables in parallel.

By assuming a current density of 4 A/mm^2, we can say that rated current of motor is **5.8 A**.

So our total rated power becomes: $\sqrt{3}x5.8x24 \cong \mathbf{240}\boldsymbol{VA}$

Now let us calculate the resistance.

AWG20's resistance is given as 84.22 mΩ/m. Since we use 3 in parallel this will be about 28 mΩ/m for our design. Each cable travels length and end-winding for 2N times. So total path is about (length + diameter)*2N m. It corresponds to **274 mΩ**.

In this case total copper lose becomes **27 W**.