EE568 - Selected Topics on Electrical Machines

Project - 2

Motor Winding Design & Analysis

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# Integral Slot Winding Design

In this part, a 20 pole 120 slot machine winding is designed. In order to reduce harmonic distortion, 5/6 short pitched winding is used.

Winding diagram for 5/6 short pitched winding is shown in table 1.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A1 | A2 | -C1 | -C2 | B1 | B2 | -A3 | -A4 | C3 | C4 | -B3 | -B4 |
| A40 | -C39 | -C40 | B39 | B40 | -A1 | -A2 | C1 | C2 | -B1 | -B2 | A3 |

# Part2

# 2D FEA Modeling

In this part, a three phase 20 pole 24 slot permanent magnet machine is simulated by using 2D FEA tool. 2D drawing is shown in figure 1.

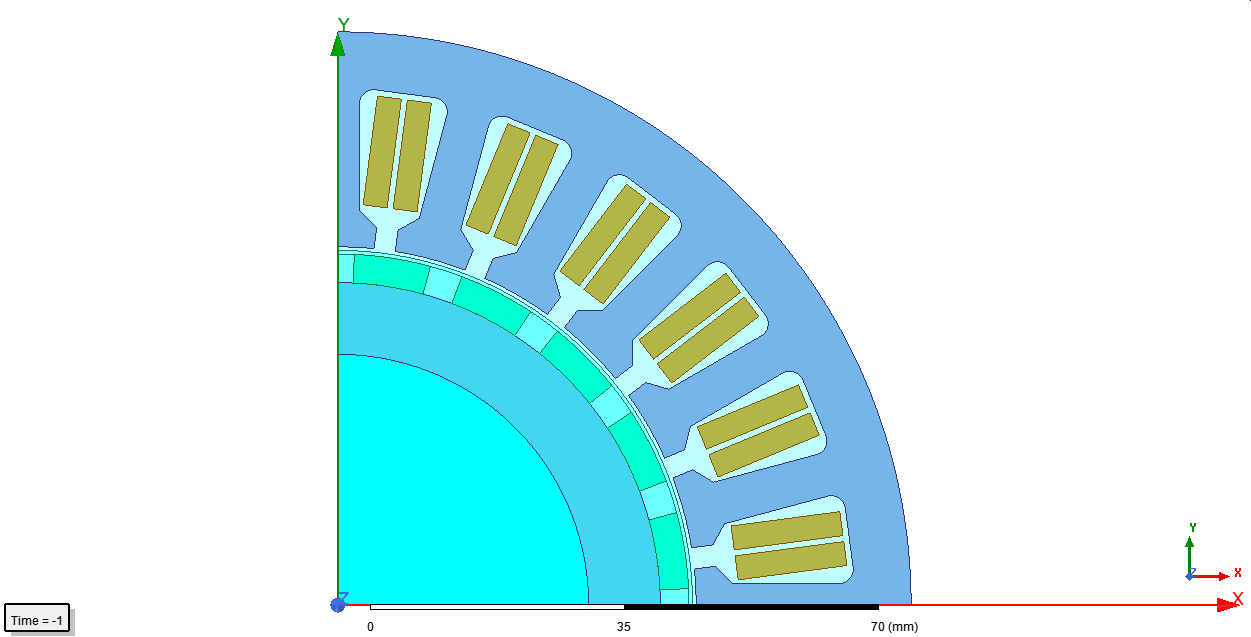


Figure 1

Winding diagram is shown in figure 2.

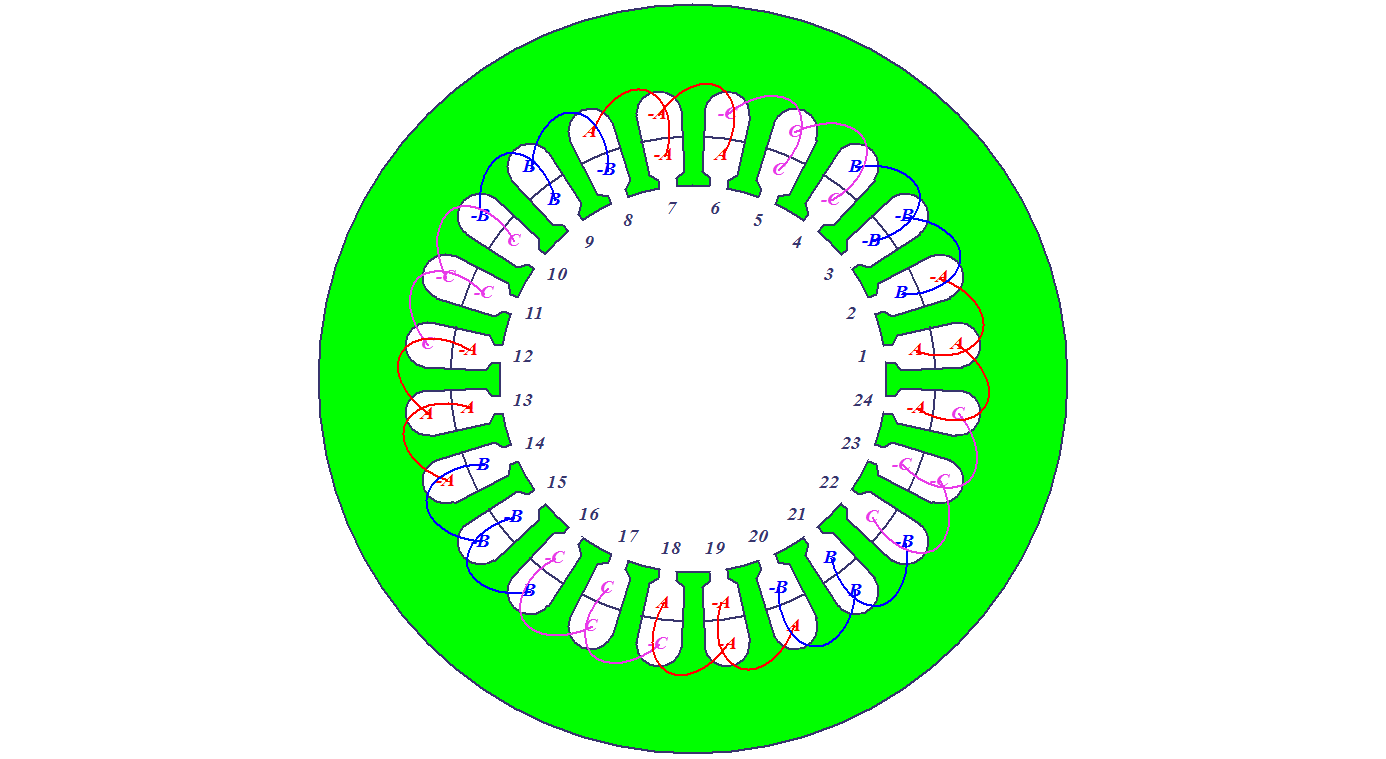


Figure 2 Winding diagram

Flux density distribution is shown in figure 3.

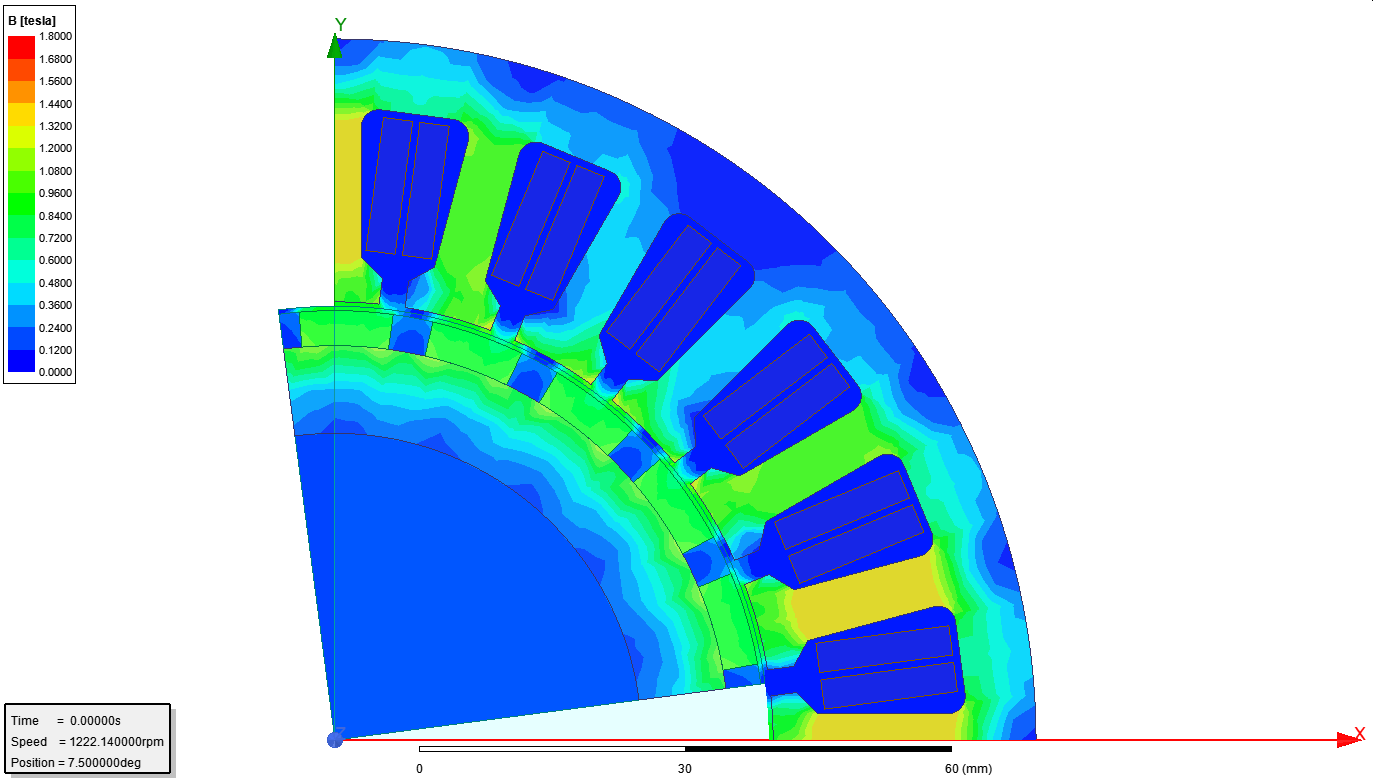


Figure 3 Flux density distribution

Through the air-gap region, a curve is drawn and B with respect to normal of the curve calculated. Result is shown in figure 4. The air gap flux density distribution graph is not smooth and perfect. This is caused by stator tooth. Since stator tooth is ferromagnetic, flux tends to go through them changing its ideal route. This is why flux density distribution through air gap doesn’t seem perfect. This is also the reason why cogging torque appears.

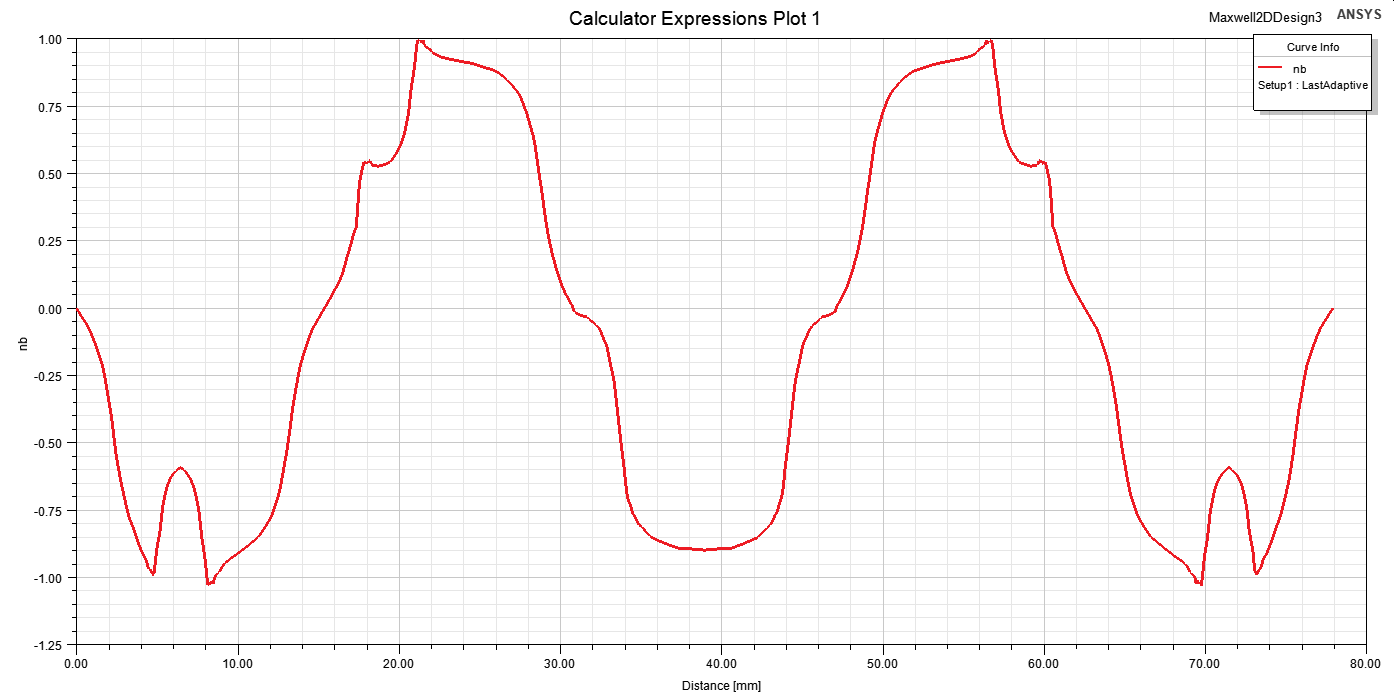


Figure 4 Air-gap flux density

Induced three phase voltages and phaseA-phaseB line to line voltage is shown in figure 5. The orange one is line to line and rest is phase voltages.

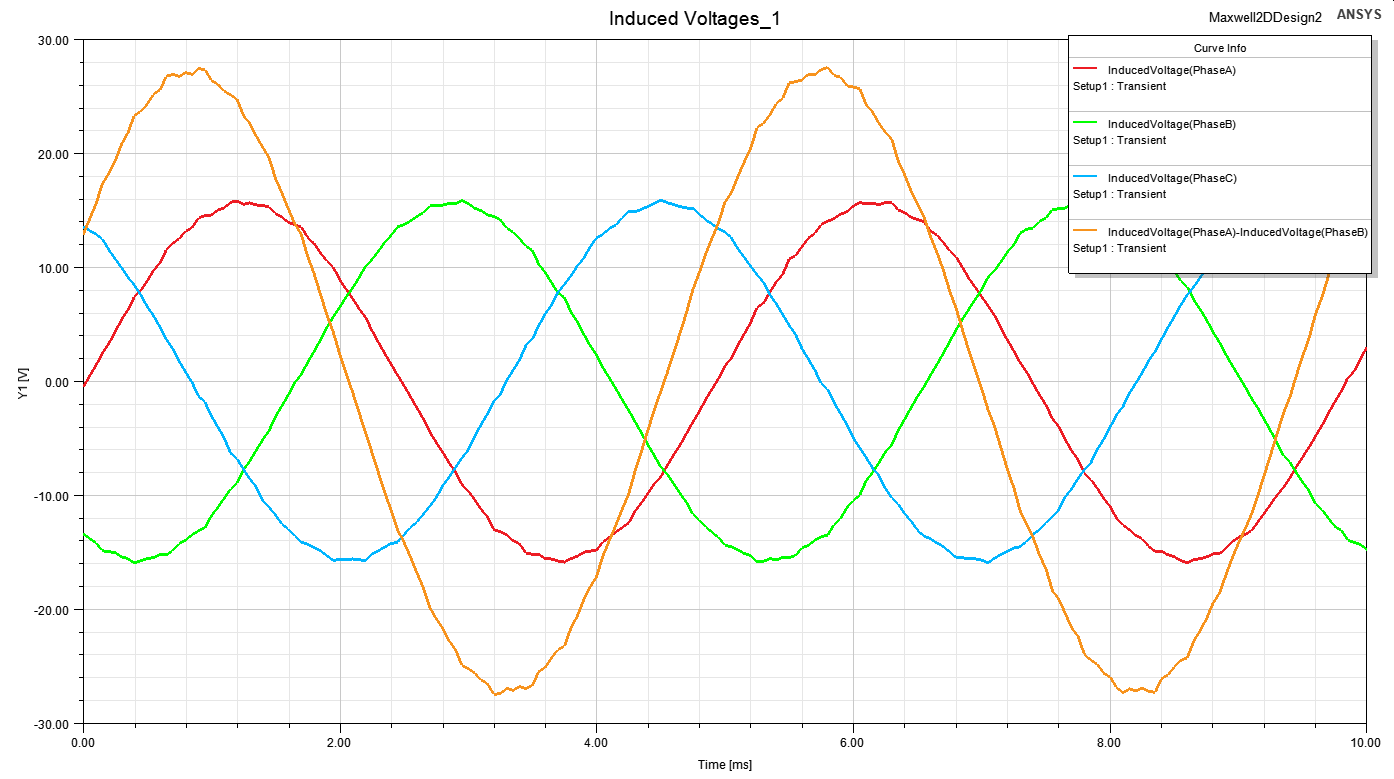


Figure 5 Phase A, B, C and PhaseA-PhaseB voltages

Mechanical torque of the machine is shown in figure 6. This graph is generated when there is no excitation resulting in only cogging torque of the motor. This cogging torque is produced because of interaction between tooth and permanent magnets.

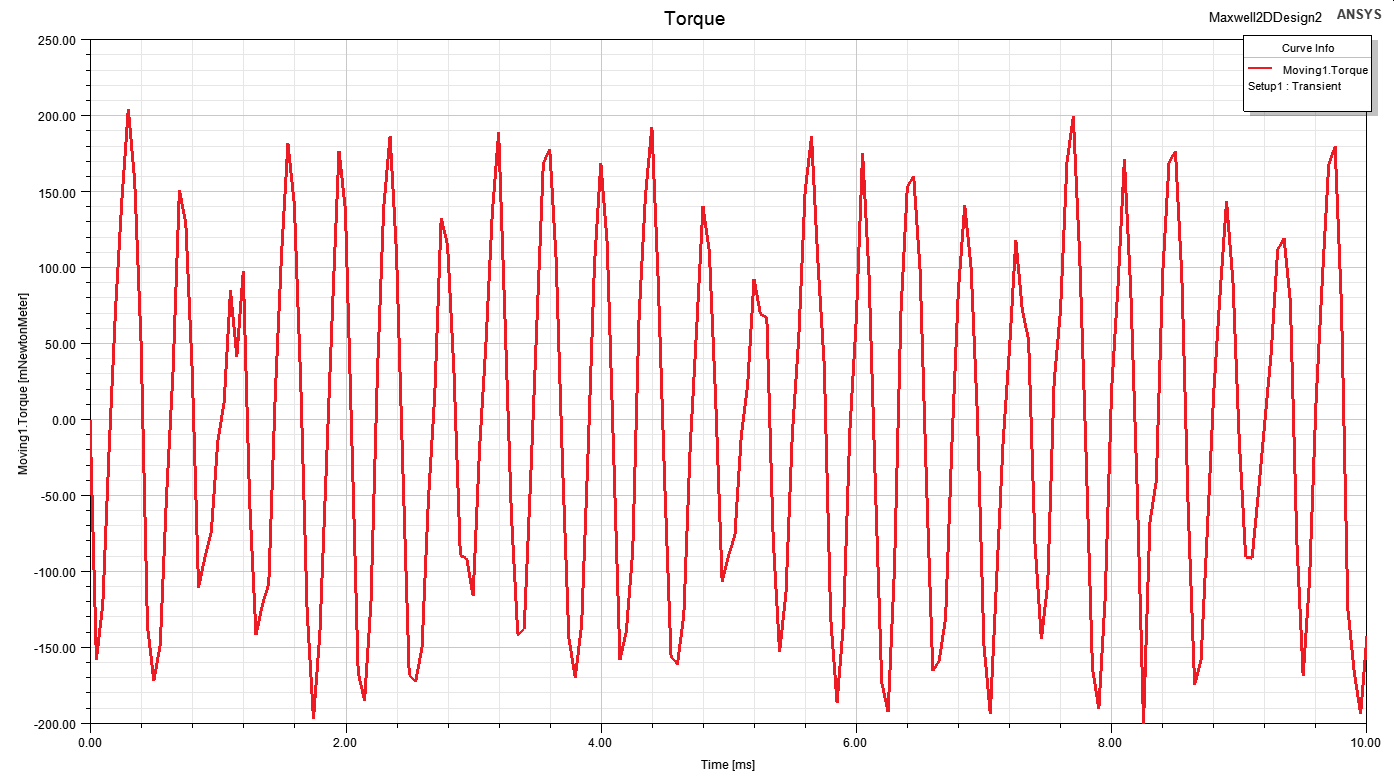


Figure 6 Cogging torque