# Introduction

In this project, Surface Mount Permanent Magnet Synchronous Machines are going to be analysed with different design criteria. Throughout the project following parameters are kept constant;

* Number of phases: 3
* Number of poles: 4
* Motor Axial Length: 100 mm
* Air-gap clearance: 1 mm
* Magnet to Pole Pitch Ratio: 0.8

# Q1-Magnetic Loading

In this part, machine is constructed with NdFeB magnets with following parameters;

* Magnet Type: NdFeB N42 grade (ur=1.05), radial shaped
* Rotor Diameter: 100 mm
* Magnet Radial Thickness: 4 mm

Motor geometry can be seen in Figure 1.

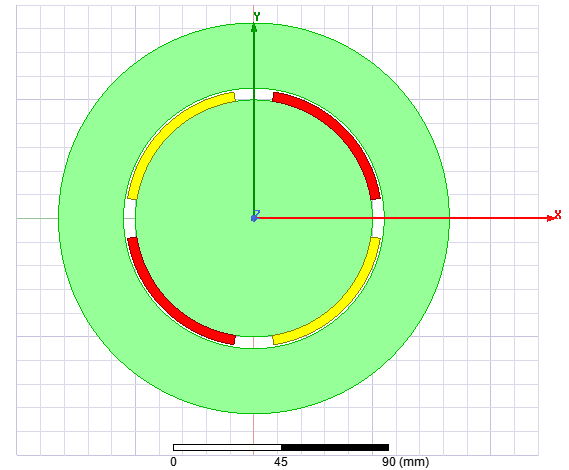


Figure 1: Geometry of constructed machine

## Part a)

Magnetic equivalent circuit for one pole pair can be seen in Figure 2. In this figure, MMF\_M1 and MMF\_M2 show permanent magnet sources whereas R\_M1 and R\_M2 show reluctances of permanent magnets.

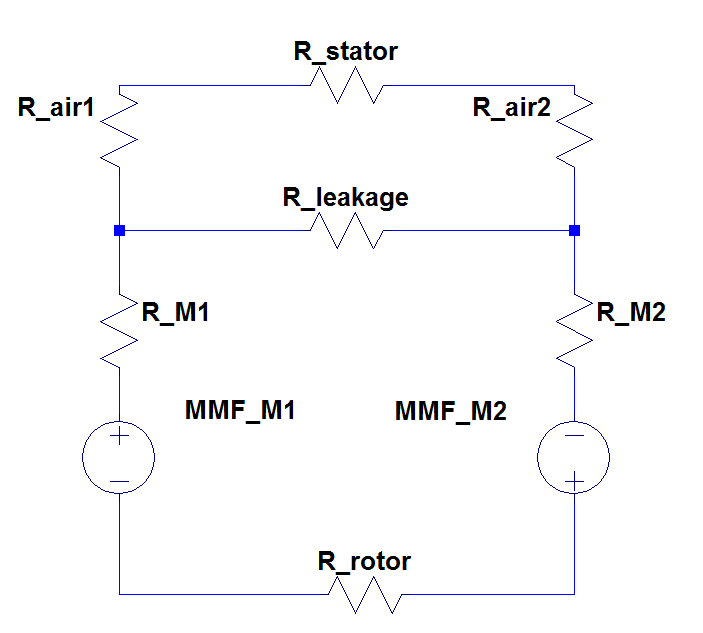


Figure 2: Magnetic equivalent circuit for one pole pair

Some assumptions are made for calculating operating point of the magnet. Stator and rotor reluctances are taken zero and leakage reluctance is taken infinite. Pole area can be calculated as;

Magnet to pole pitch ratio is 0.8 therefore magnet and air gap area can be calculated as;

Reluctances can be found as;

Permanent magnet MMFs can be calculated as;

By solving magnetic equivalent circuit, magnetic flux density can be found as;

By using magnet normal curve, operating point of the magnet can be calculated by load line as seen in Figure 3. Hm of the magnet is found as -198.5 kA/m.

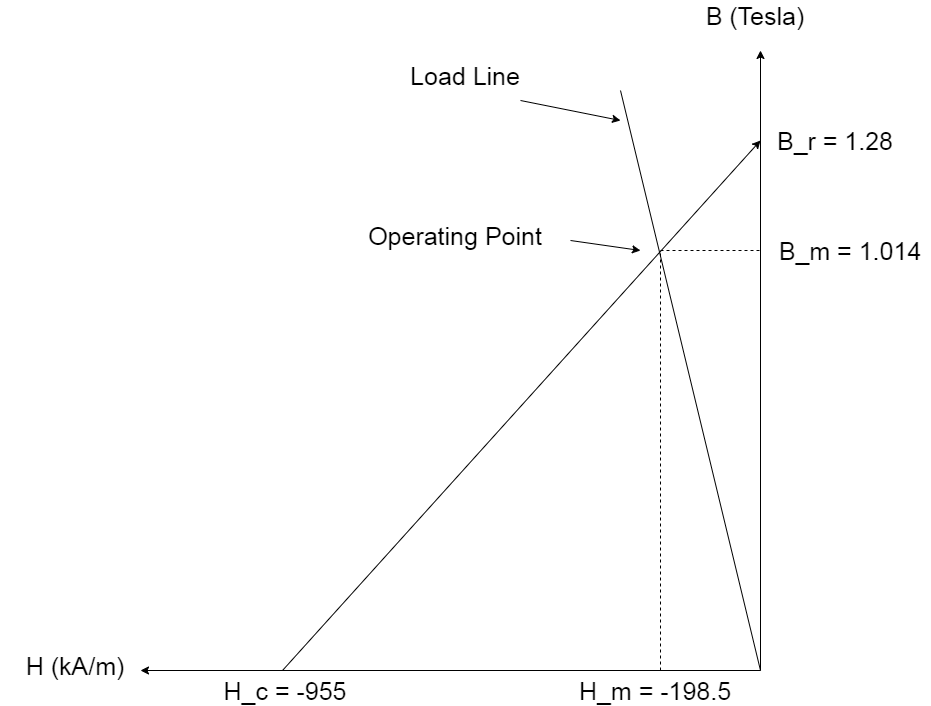


Figure 3: Normal line and load line of the magnet

## Part b)

Magnetic loading of the machine can be calculated as;

## Part c)