EMAG Recuitment

Task 3B

Synchronous Machines - Part B

Powertrain Department

1 Introduction

Now that you understand the basics about synchronous machine, you are able to take a step ahead and learn how to design a new geometry for the stator and rotor, and how to achive the objetive parameters for the machine.

2 Design of a synchronous motor

In this Part B of the third task, let's consider the synchronous motor of the previous task. The name plate data of the motor is presented in the following table:

Nameplate Data	
Armature Voltage [V]	400
Armature Current [A]	1.75
Field Current [A]	0.5
Frequency [Hz]	50
Power Factor	0.8
Power [kW]	1.0
Speed [RPM]	1500
Maximum Torque [Nm]	4.6
Number of pair of poles	2

Table 1: Synchronous Motor - Nameplate.

The initial geometry of the motor is shown in figure 1.

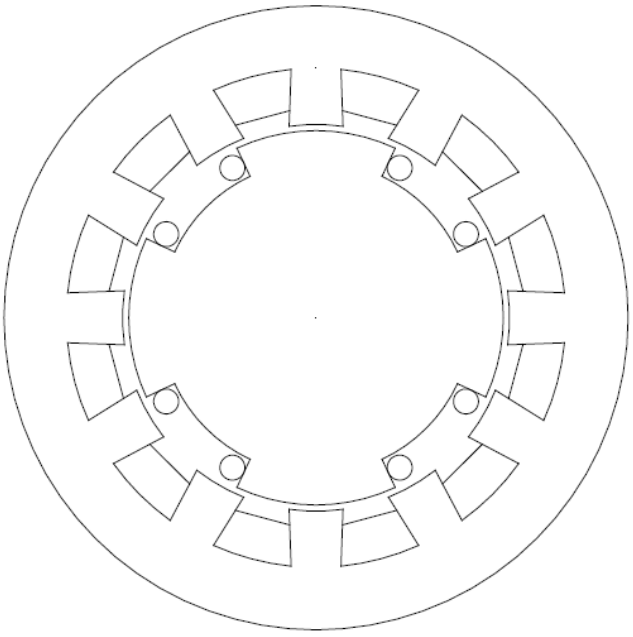

Figure 1: Synchronous Motor - Initial Geometry.

Consider now that you are meant to design a motor with similar characteristics to this one. This means, a motor that for the same field and armature current, same frequency and number of pairs of poles, produces the same maximum torque.

You should try to accomplish this objective by making some simulations on Comsol and making the modifications that you think will allow you to reach the goal, by using Solidworks.

As starting point, you should use the initial geometry presented in figure 1, also given in the appendix drawing.

There are some **limitations** to the design of the motor, that you must take into account:

(a) The outsider diameter of the motor cannot be exceeded;

(b) The length of the motor cannot exceed 10 cm;

(c) The phase resistance must be at least 100 times less than the phase reactance;

(d) The maximum number of turns in the feld is 80 turns;

(e) The power angle produced must be 90 electrical degrees;

(f) The minimum value of the air gap is 0.7 mm.

Do not forget:

(i) The coils in stator must fit in the slots;

(ii) The number of turns must be proportional to the area of the slot.

3 Report

1. Show all the geometry iterations you made to achieve the objective and justify them. Also provide all the information about the parameters chosen for the Comsol simulations:

   (i) The number of turns used in the slots of the armature;

   (ii) The type and dimensions of the cooper windings;

   (iii) The number of turns in parallel;

   (iv) The air gap value;

   (v) The motor's length:

   (vi) The area of each slot;

   (vii) The core material.

   Present all the important information obtained through the Comsol simulations (figures, plots, other important data).

2. After achieving the objective torque, prove that this is produced at a power angle of 90 electrical degrees.

4 Final Notes

Feel free to include in the report more information that you may find interesting about the subject, you are not restricted to the questions in the last section.

This is probably the most difficult task you are meant to do so far, having said so, do not hesitate to ask any doubt that you may have. As always, you can e-mail to make any question, or you can show up in team's Discord.

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