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EEE3091F

Induction Motor Project Report

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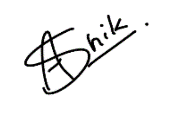
03/04/2023

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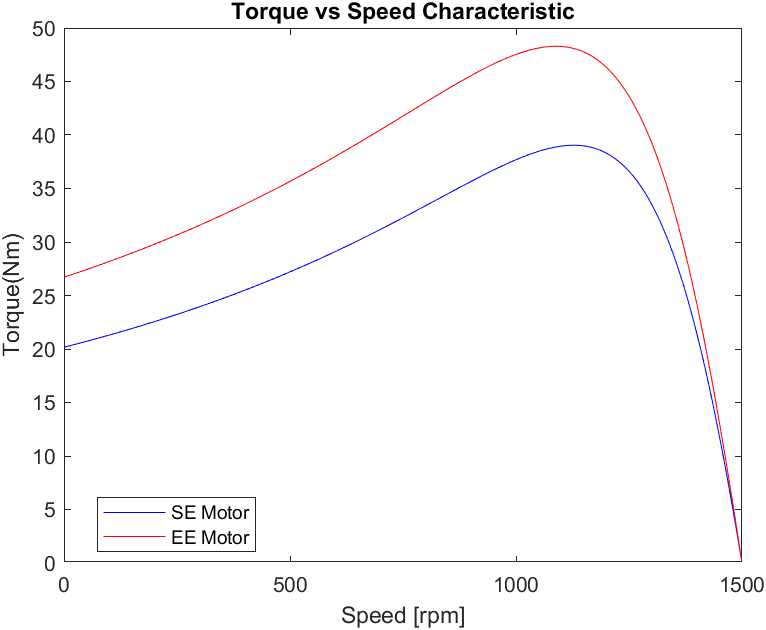
Ankush Chohan (CHHANK001) Ashik John (JHNASH009)

Date: 03/04/2023

**Part A – Matlab Code**

|  |  |  |
| --- | --- | --- |
|  | **SE Motor** | **EE Motor** |
| **Vth** | 206.07 V | 208.82 V |
| **Rth** | 1.84 Ω | 1.36 Ω |
| **Xth** | 4.07 Ω | 3.49 Ω |

1.

****2.

1. SE Motor: 20.17 Nm

EE Motor: 26.71 Nm

Starting torque can either be altered by changing the rotor resistance (increasing rotor resistance increases starting torque), or by changing the supply voltage (starting torque increases as supply voltage increases).

1. SE Motor: 39.04 Nm

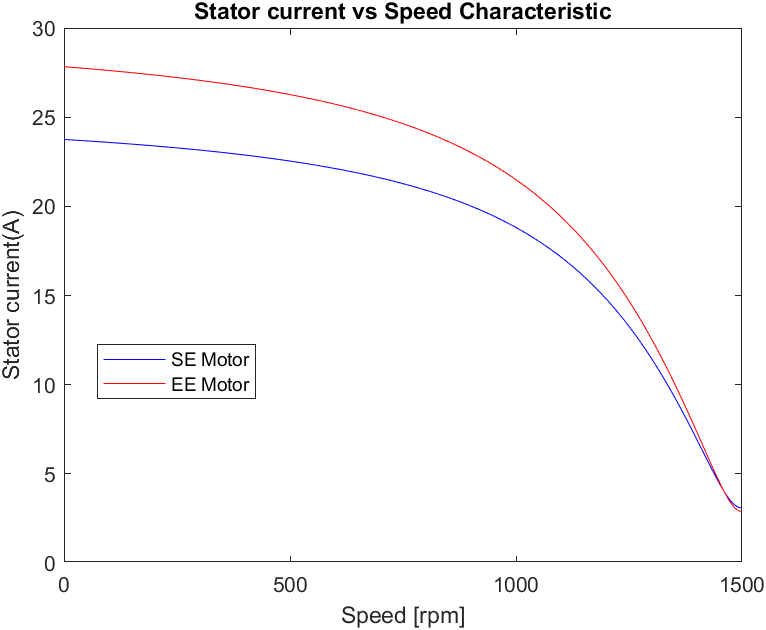
EE Motor: 48.29 Nm

This value can be altered by changing the supply voltage. Maximum torque is directly proportional to the square of the supply voltage.

1. SE Motor: 1127 rpm

EE Motor: 1088 rpm

The speed at which the maximum torque occurs can be altered by changing the rotor resistance, by means of adding external winding resistance. Increasing the rotor resistance decreases the speed at which the maximum torque occurs.

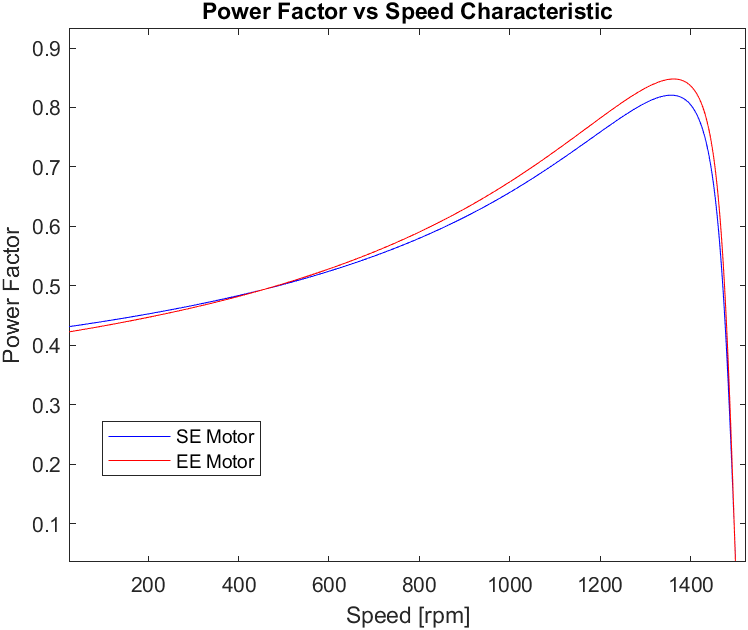
3.

1. The result is as expected, with start-up currents typically being about 500% the full-load currents. This is because at start up, the slip is close to 1, and the impedance of the circuit will be low, drawing large amounts of current. It can be seen that the start up current of the Energy Efficient motor is about 4A higher than that of the standard motor. This is expected, since the stator and rotor resistances, as well as reactance’s of the EE motor is lower than the SE motor. Lower Impedance will draw higher current on start-up.
2. Regardless of the load at start-up, the stator current will be the same, this is because the rotor speed will be close to zero, meaning the slip would be close to 1. With a slip of 1, the impedance associated with the rotor and parallel branch of the equivalent circuit will be low. The load does not affect the rotor speed at start-up, as the rotor will always start from rest.
3. SE Motor: 16.59 A

EE Motor: 19.69 A

1. SE Motor: 3.10 A

EE Motor: 2.89 A

4.

1. SE Motor: 0.429

EE Motor: 0.419

1. SE Motor: 0.7196

EE Motor: 0.7200

1. SE Motor: 0.044

EE Motor: 0.037

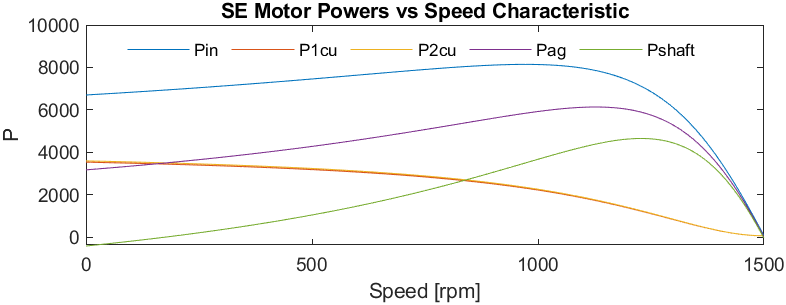
The results are as expected. At high speeds, the impedance of the rotor branch becomes very high due to the low slip level. As a result, current will only be drawn by the magnetising branch, and thus the circuit will be largely inductive. The high inductance leads to a very low power factor. The magnetising inductance of the EE motor is higher, so it will have a lower power factor.

1. SE Motor: 0.821

EE Motor: 0.848

1. SE Motor: 1357 rpm

EE Motor: 1363 rpm

5.

**Chart, line chart

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|  |  |  |
| --- | --- | --- |
|  | **SE Motor** | **EE Motor** |
| **Stator Copper Loss** | 3531.63 W | 3485.26 W |
| **Rotor Copper Loss** | 3590.86 W | 4633.07 W |

|  |  |  |
| --- | --- | --- |
|  | **SE Motor** | **EE Motor** |
| **Stator Copper Loss** | 59.98 W | 37.58 W |
| **Rotor Copper Loss** | 60.98 W | * 1. W |

**Chart, line chart

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1. SE Motor: 55.8%

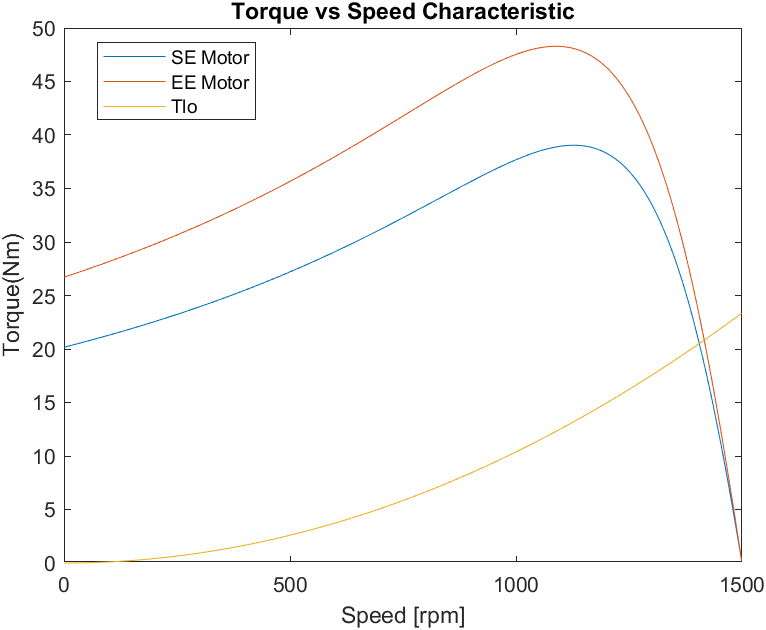
EE Motor: 56.5%

1. SE Motor: 87.4%

EE Motor: 90.3%

1. SE Motor: 1455 rpm

EE Motor: 1460 rpm

7.

1. SE Motor: 1405.5 rpm

EE Motor: 1416.75 rpm

1. SE Motor: 6.65 A

EE Motor: 6.39 A

1. SE Motor: 84.02 %

EE Motor: 87.57 %

1. SE Motor: 2940.48 W

EE Motor: 3016.76 W

1. SE Motor: 3499.64 W

EE Motor: 3445.11 W

Yes, these input power differences between the two machines are expected. The EE motor, with higher efficiency than the SE Motor, was able to draw less power (3445W < 3499.64W) but still output more power to the shaft than the SE Motor (3017W > 2940W). The benefits of the energy efficient motor are therefore evident.

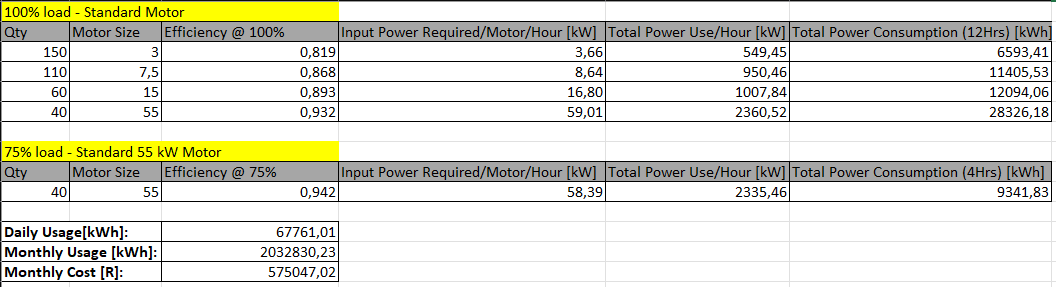
**Part B – Theoretical Questions**

1.

(a) Bigger motors can make use of larger copper windings in the stator and rotor. Larger windings mean less resistance, and therefore less copper losses. Less losses means greater efficiency.

(b) Underloading motors decreases the efficiency of the machine. The machines are optimised to have the highest efficiency at the rated load. Characteristics such as torque and current would not be at rated levels, decreasing efficiency.

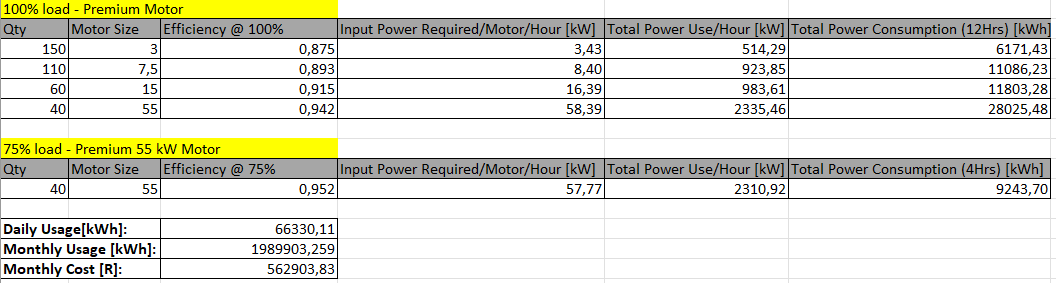
2.

(a) The following calculations were made:

From this,

Monthly usage: **2 032 830.23 kWh**

Monthly bill: **R 575 047.02**

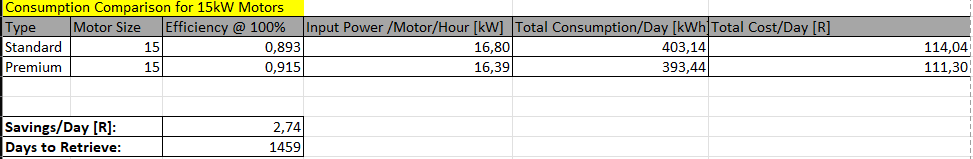
(b) The following calculations were made:

From this,

Monthly usage: **1 989 903.26 kWh**

Monthly bill: **R 562 903.83**

(c) The savings from installing premium motors/month will be: **R 12 143.18**

3. Based on the calculations below, it would take 1459 days to retrieve the money.

**APPPENDIX: MATLAB CODE**