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ASIA PACIFIC UNIVERSITY
OF TECHNOLOGY & INNOVATION

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Contents

INTRODUCTION

A transformer is a static electrical machine which transforms alternating electrical power from one voltage and current level to another voltage and current level by means of an intermediate conversion to a magnetic field. It consists of two or more isolated windings, of a certain resistance and self-inductance, which are coupled by mutual induction (M), i.e., by mutual magnetic fluxes which must be time-varying for transformer action (e.m.f.) to exist.

This magnetic link defines the values of the inductances (L) and will depend on the nature of the magnetic circuit, i.e., its magnetic reluctance, which is a function of the material used, and of the existing dispersed flux (ϕl), which generally has a different reluctance to that of the mutual flux. On the other hand, the stray and magnetizing inductance is a function of the square of the number of turns, but the mutual inductance depends on the product of the number of turns.

An electric motor is a machine that converts electrical energy into mechanical energy. Its principle supports the following statement: When a current conductor is placed in a magnetic field, it experiences a mechanical force.

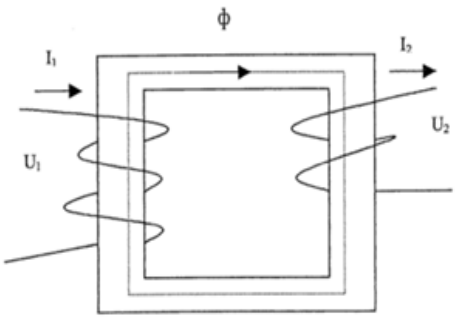


Figure 1: Simplified Transformer Schematic.

Figure 2: DC Motor schematic

Note:

MATLAB R2022a is being implemented to obtain the electrical components, as well as the Simulink and Simscape libraries.

TABLE OF INPUTS VALUES

- **Resistance, armature current and speed**
  Voltage is set as 220V

Resistance	Armature current	Speed rad/s	Speed rpm
30.5	3.279	71.53	683
40.5	3.033	57.79	551.8
50.5	2.758	47.91	457.5
60.5	2.507	40.51	386.9
70.5	2.287	34.79	332.2

Table 1

- **Resistance, field current and speed**
  Voltage is set as 250V

Resistance	Field Current	Speed rad/s	Speed rpm
25	0.7547	146.9	1403
30	0.7407	149.7	1429
35	0.7273	152.4	1456
40	0.7143	155.2	1482
45	0.7018	158	1508

Table 2

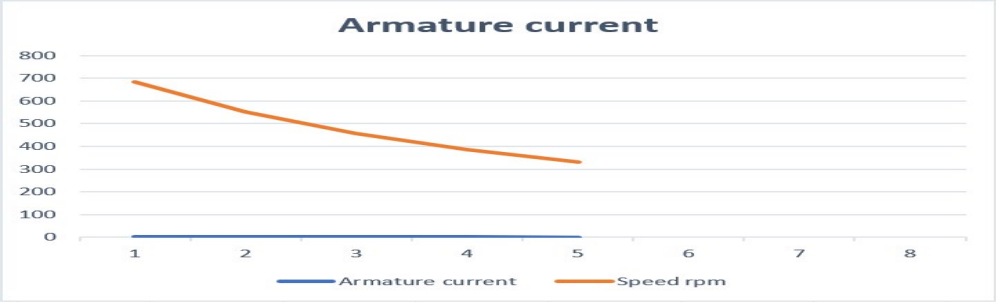
- **Resistance, voltage, and speed**

  Field initial current value is set as 2.308 with V=600, Resistance=20

Resistance	Voltage	Speed rad/s	Speed rpm	Field Current
20	600	144.4	1379	2.308
30	623.2	150	1432	2.308
40	646.24	155.5	1485	2.308
50	669.32	161.1	1538	2.308
60	692.4	166.6	1591	2.308

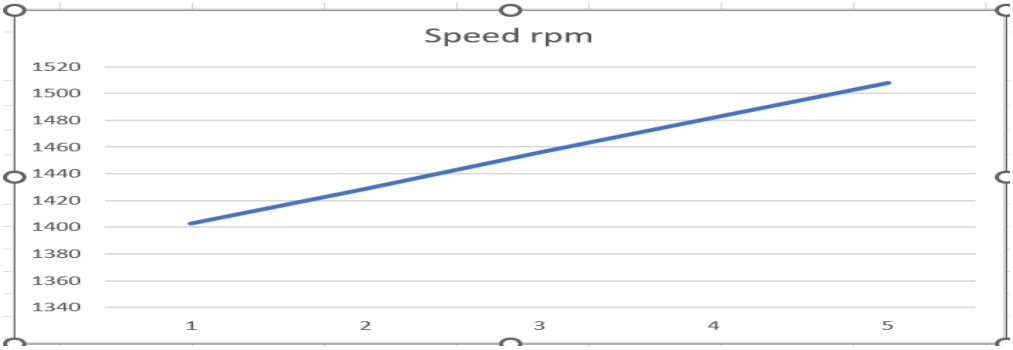
Table 3

GRAPHS FOR THE INPUTS



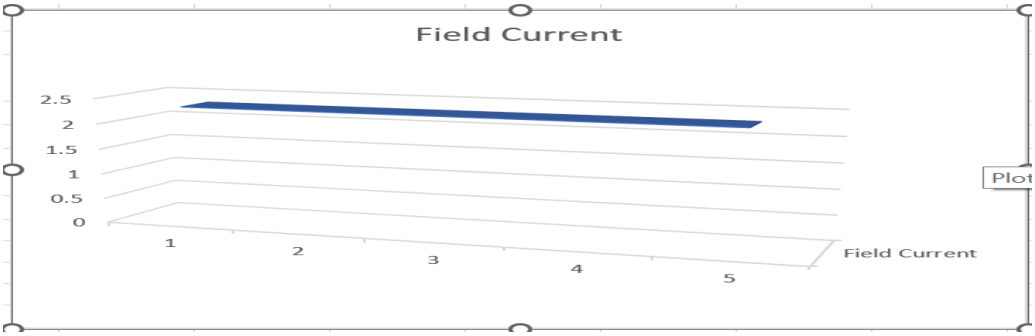
Graph 1

In this graph we can appreciate the fact that the speed is decreasing whereas the armature current is increasing along the way with the speed due to the change in the resistance.



Graph 2

Graph 2 is the representation of the field current where the voltage has been set as 250 by default, so the speed is rising or increasing.



Graph 3

Graph 3 is where the field current is constant, it does not change as we change either the voltage or the resistance, the field current remains the same value.

ANALYSIS FOR OPEN CIRCUIT

OPEN CIRCUIT

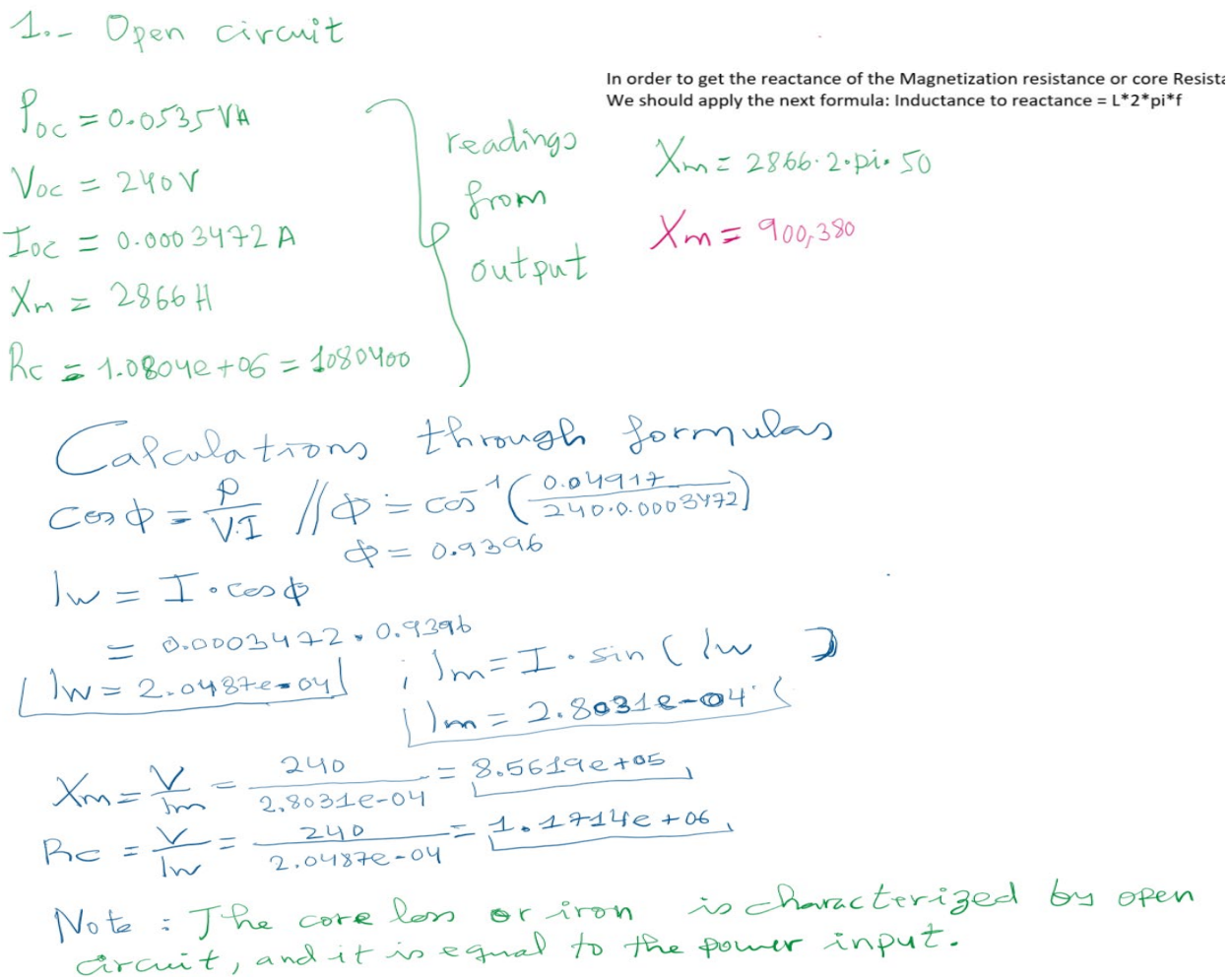


Illustration 1: calculations

TABLE OF RESULTS FOR THE READINGS AND THE CALCULATIONS

	Values obtained from output(simulation)	Values obtained from calculations(formulas)
Xm	900380	856190
Rc	1080400	1171400

ANALYSIS FOR SHORT CIRCUIT

SHORT CIRCUIT

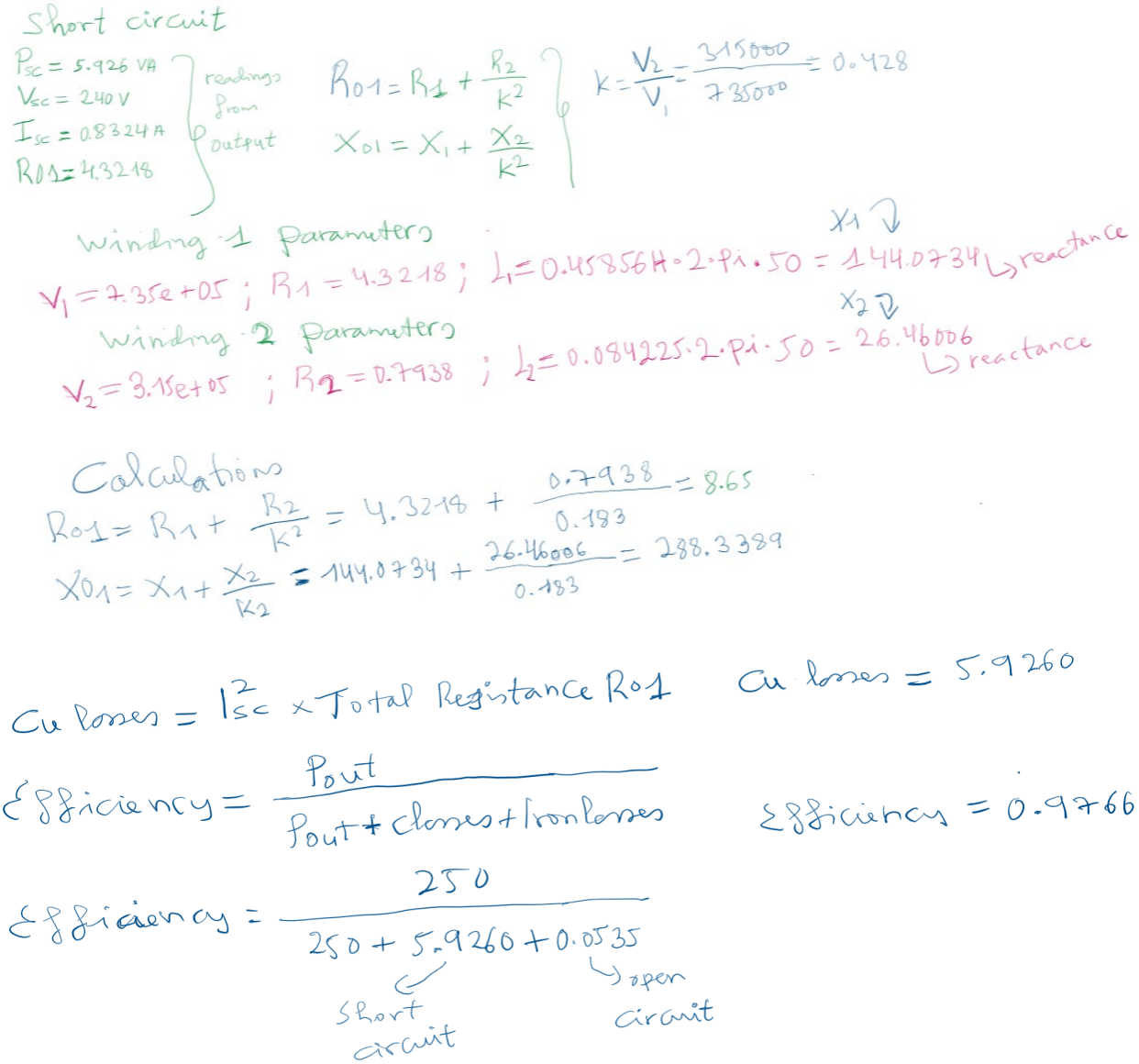


Illustration 2: calculations

TABLE OF THE RESULTS, READING, AND CALCULATIONS (Short Circuit)

	Values obtained from output(simulation)	Values obtained from calculations(formulas)
R01/R1	4.3218	4.2763
X01	144.0609	144.1456

ANALYSIS OF OPEN AND SHORT CIRCUITS

- Properties setting of the voltage output

  The property setting has been set by default, i.e., no parameter values have been manipulated or changed in the property setting apart from the frequency which has been set to a value of 50Hz.

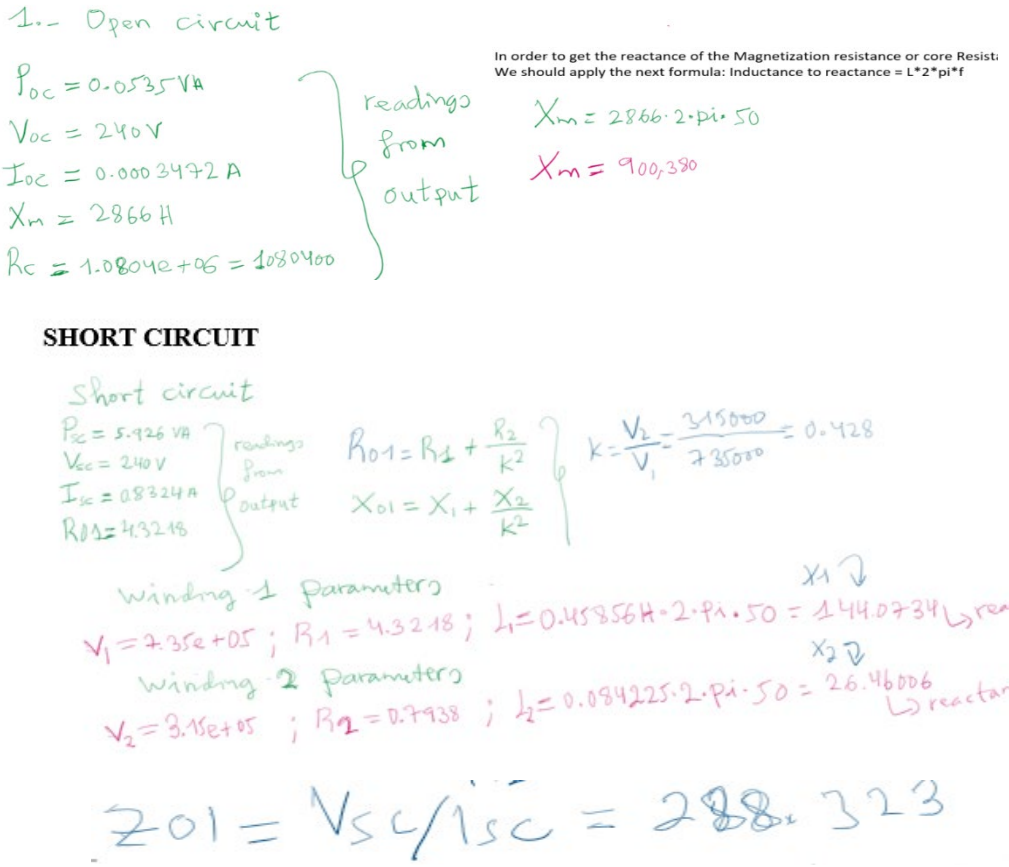
- Power, current, and voltage output

  Can be observed from illustration 2 for both open and short circuits.

- Iron and copper losses of the transformer

  In open circuit iron loss is equal to the power input which is 0.0535 while the cupper loss is equal to 5.9260. You may refer to both illustration 1 and 2 above to get more insights.

- Equivalent resistance, reactance and impedance of both core and winding of the transformer



$$\text{Cu losses} = I_{sc}^2 \times \text{Total Registance Rot} \qquad \text{Cu losses} = 5.9260$$

$$\text{Efficiency} = \frac{P_{out}}{P_{out} + \text{closses} + \text{Iron losses}} \qquad \text{Efficiency} = 0.9766$$

$$\text{Efficiency} = \frac{250}{250 + 5.9260 + 0.0535}$$

5.9260 → Short circuit

0.0535 → open circuit

DIAGRAM USED IN THE ASSIGNMENT

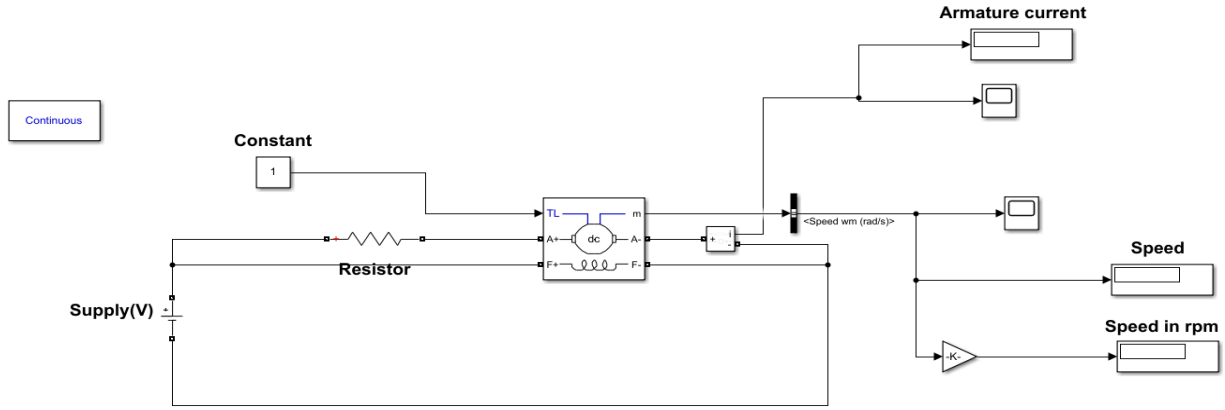


Diagram 1 which defined the simulation of armature current, speed, and speed in rpm as outputs by controlling the supply and the resistor.

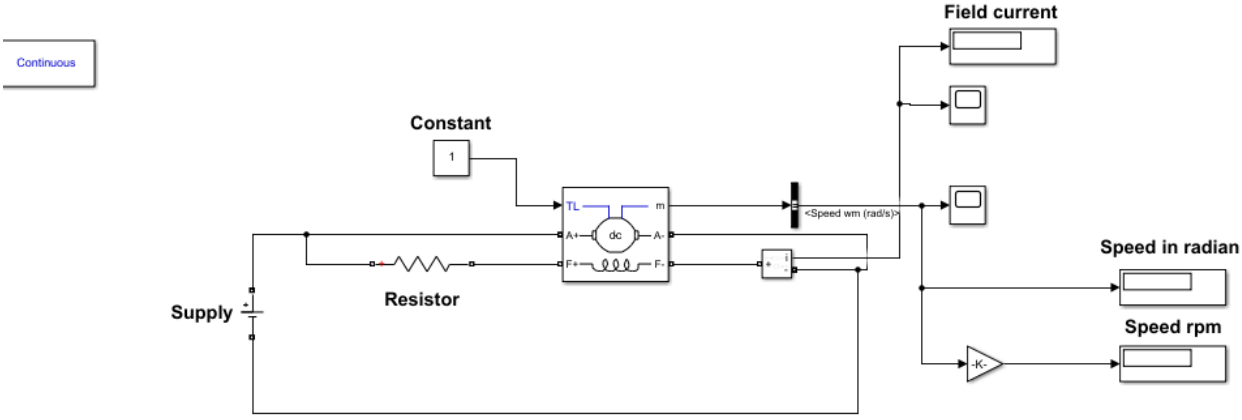


Diagram 2 where we can obtain the values for field current, speed, and speed in rpm as the outputs by controlling the resistance and the voltage.

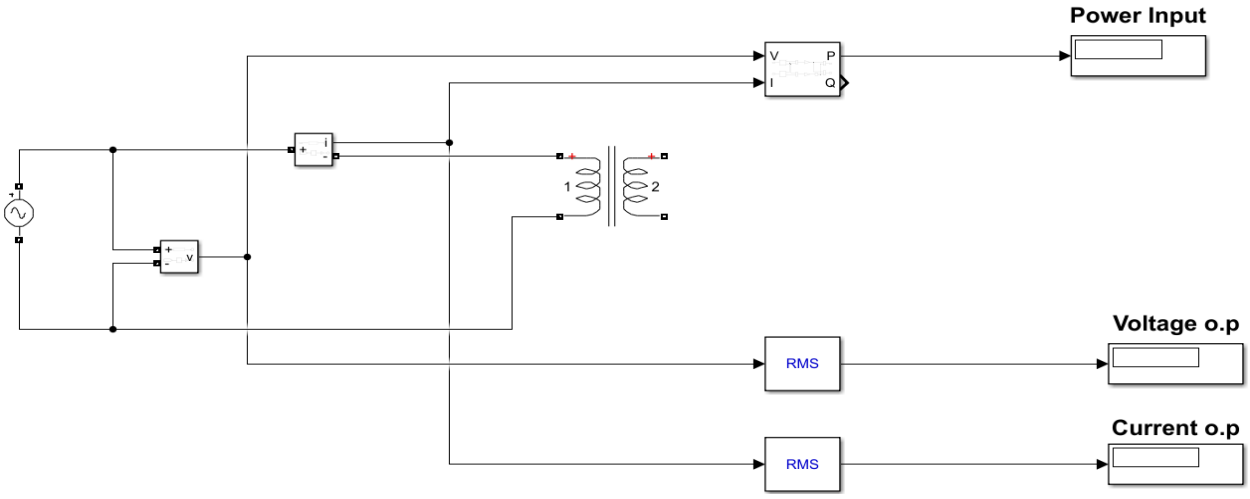


Diagram 3 is specialized in the treatment of open circuit where we have fixed a fixed voltage input and frequencies to control or get the power input, voltage, and current of the transformer in open circuit.

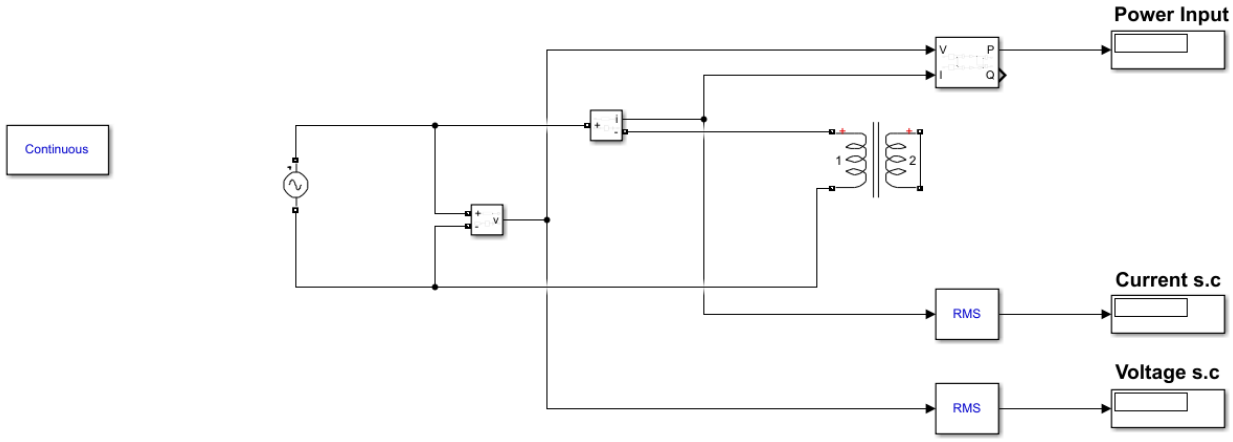
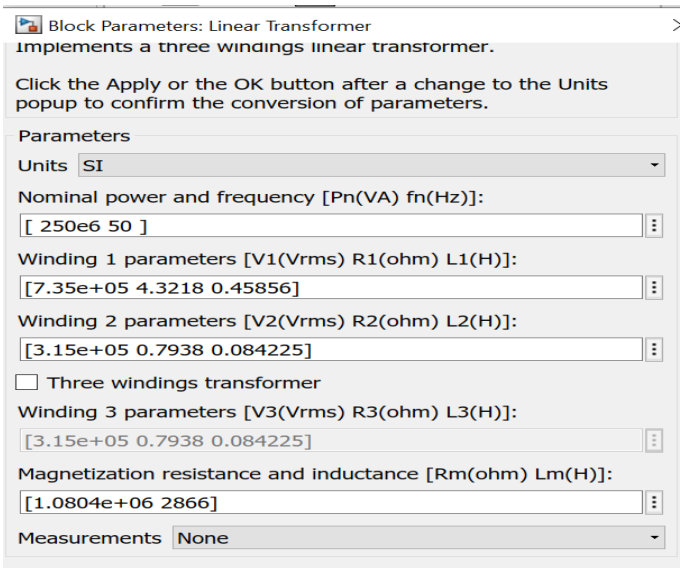
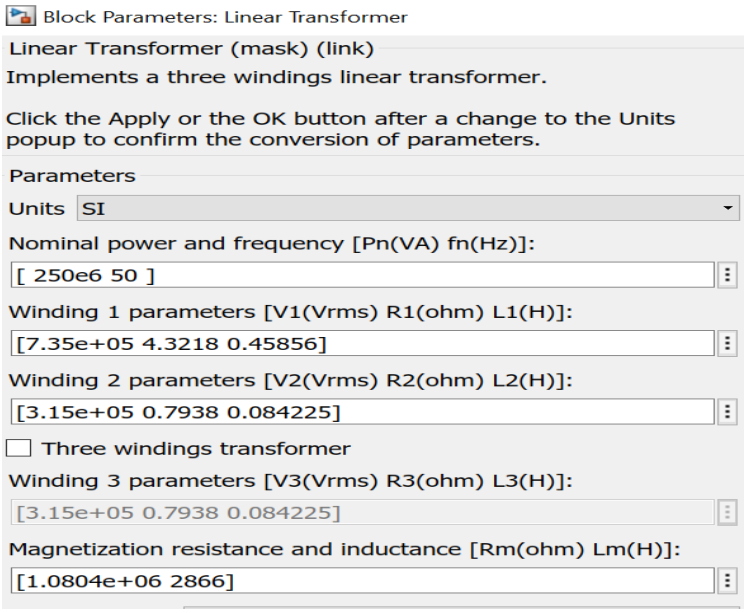


Diagram 4 is a representation of short circuit where we can get the power input, current, and voltage through the parameters of the winding voltage.



PARAMETERS IN THE TRANSFORMER FOR OPEN CIRCUIT.



PARAMETERS IN THE TRANSFORMER FOR SHORT CIRCUIT.

DISCUSSION

In this project I have mainly used Simulink MATLAB to create or implement the diagram in order to perform the simulation for DC shunt Motor, Open, and Short circuit. In this experiment or project, it is proven that there is certain relationship between the winding parameters, readings with the values gotten in the output. There are some similarities in the values between the parameters and the output values. Regarding the other experiment in DC Motor, it has been proven that there are some relationship between the speed and the armature current, as well as the speed and field current while we are able to manipulate the voltage and the resistor to maintain the field current as a constant.

CONCLUSION

In this research project I completed the lab report by showing the expected values through simulations to get the output values which I used to compare with the expected values considering the values of the winding parameters of the transformer as well as being able to determine or analyze the relationship of speed and armature current, and field current.

REFERENCES

None.