

# Agenda

Date: February 15

Time: 3:30 pm

Location: Power lab laboratory.

Team member: Yuanchen Yan , Jintong Zhang, Khalid Almutairi

agenda

Goal: Giving us the introduction of power lab. We need to know how to use these machine. We can discuss about the machine as well. We also can discuss the budget about this project. We hope to have a good start about this project.

Date: 2/21/19

Time: 3:30PM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

## Agenda

1. Team contract final draft.
2. What software should we use?
3. Deadline? We would like to know if we have to finish a specific part before the spring break other than doing some research and reading.
4. Snapshot? What are we support to do in the first snapshot? Is it 30 seconds presentation telling the students about our project?
5. We would like to do an experiment on how the synchronous machine works.  
(this may take some time so let's do it at the end if we have enough time).

Date: 2/27/2019

Time: 12:15PM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

## Agenda

1. We want to do an experiment from one of the next three:

Voltage-----different voltages

Voltage-----voltage per hertz

Voltage boost

Date:3/1/2019

Time: 3:30PM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

### Agenda

1. We want to do an experiment about voltage per hertz
2. We have some problems about the snapshot on March,5.  
Do we need to do the experiment on that day?  
If we finish the experiment, what should we show them?
3. How is the poster like?  
Are there just some pictures about the experiments?
4. Do we need to finish the website before that day?
5. Review the things that we did on Wednesday.

Date:3/5/2019

Time: 12: 30AM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

#### Agenda

- 1 . Review the experiment what we learned in the last meeting.
- 2 . Give us more knowledge about three machines so we can speak it in snapshot better.
- 3 . We should know more about the experiment we have learned.
- 4 . Adjust our attitude, hope we can succeed in our snapshot.

Date: 3/8/2019

Time: 11:30AM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda

1. Checking our homework,
2. Review the experiment what we did in last meeting.
3. Review what we did in the snapshot. What could have been done better?
4. Wikipage? Do we need to upload any experiment that we do in the lab or just the ones that we will design.
5. Budget? Since the lab has everything we need, do we really need to buy new equipment?

Date: 3/21/2019

Time: 3:30AM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda

1. Review what we did last time
2. Wikipage? Do we need to upload any experiment that we do in the lab or just the ones that we will design.
3. Budget? Since the lab has everything we need, do we really need to buy new equipment?
4. We would like to do a new experiment if we have enough time 😊

Date:03/27/2019

Time:12:30PM

Location: Power Lab Laboratory

Attendance:Dr.Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda:

1. Discuss two questions that we came up with for each other.
2. Do a new experiment.
3. What budget will do in the next few weeks.



Date:03/29/2019

Time:15:30PM

Location: Power Lab Laboratory

Attendance:Dr.Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda:

4. We have to design an experiment about DC machine and induction.
5. Try to understand the connection and know the purpose of it.
6. What budget will do in the next few weeks.

Date:04/05/2019

Time: 3: 30PM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

### Agenda

1. Checking our homework and give us some comment.
2. Reviewing the experiment we had learned for last meeting.
3. Learning a new experiment. (You said we need to learn how to use synchronous machine later).

Date: 4/10/2019

Time: 12:30AM

Location: Power lab laboratory (GJL 102).

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda

1. Review the expectation of the design review
2. Experiment on the synchronous machine

Date: 4/12/19

Time: 3:30PM

Location: Power lab laboratory.

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

### Agenda

1. Review the expectation of the design review
2. Review DFIM

Date:04/26/2019

Time: 3:30pm

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda:

1. Talk about the design review.
2. What do we need to do in the next few weeks?
3. What's the plan for the next semester?

# Record

Date: 2/15/19

Time: 3:30PM

Location: Power lab laboratory.

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda that was discussed:

Giving us the introduction of power lab. We need to know how to use these machine. We can discuss about the machine as well. We also can discuss the budget about this project. We hope to have a good start about this project.

Things we did in the lab:

We did some experiments on the AC induction motor and we learned how it operates, and that was done by many connection that we did in the lab. Also, we did some experiments on the DC motor as well.

Other notes:

1. We should have done the team contract for the first draft.
2. Team contract has to be done by next week.
3. We need to bring our logbook for next meeting.
4. We need to contact with the ECE department in order to get the keys for the lab.
5. We need to some reading; Books that were advised : Electric Machinery Fundamentals 5th and wind turbine
6. TAs who can help Philip, Richardson

Date: 2/22/19

Time: 11.30AM

Location: Power lab laboratory.

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda that was discussed:

Answered some questions about the AC induction machine and the homework that we read.

Things we did in the lab:

We talked about the presentation on March 5

.

We propose the direction of discussion at the next meetings and the direction of experimental research. We should choose two of them to do experiments.

1. Speed
2. Direction of rotation
3. Start
4. Current
5. Voltage
6. Voltage per hertz
7. Voltage boost

Other notes:

1. We have two meets next week.
2. The homework is 6.1 and 6.4

Date:02/27/2019

Time: 12:15AM

Location: Power Lab Laboratory

Attendees: Dr.Hess, Khalid Almutairi, Yuanchen Yan, and Jingtong Zhang

***Agenda that was discussed:***

1. Our homework. (The problem is in the book 6.1 and 6.4)
2. What experiment we need to choose it? How can we do it?

***Things we did in the lab:***

Firstly, Dr. Hess gave us a problem we need to solve it. The problem is about a 60HZ motor, 4 poles, 1% slip. We need to know the speed, magnetic field angular velocity and rotor I frequency.

Solutions:  $n_{sync}=120f_{se}/p=120*60/4=1800r/min$

$$n_m=n_{sync}(1-s)=1800*(1-0.01)=1782r/min$$

$$\omega_m=1782r/min*2\text{ rad/r}*1min/60s=186.61rad/s$$

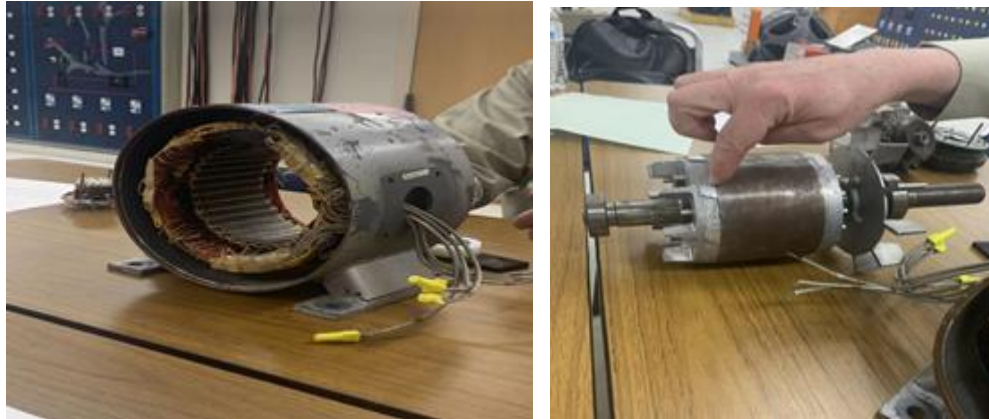
$$f_{re}=sf_{re}=0.01*60=0.6HZ$$

Then, Dr. Hess introduced us three different kinds of machine. There are induction machine, synchronous machine, and double fed machine.



## 1. Induction machine

There are pictures about Induction machine.



Stator

rotor

It is three phases, four poles. There three color consist of in this stator. Magnetic field moves around a direction then move back. If the frequency is 60HZ, it turns 30 times a second. The current can through from rotor. It will produce force in this machine. Moving magnetic field would move generator voltage.

## 2.Synchronous machine



Stator

rotor

This machine works slower. These are two machines back to back. There are 12 poles in rotor. It moves the same speed. Magnetic field moved the same speed with stator and rotor. Putting the voltage in the rotor it can work.

### 3. double fed machine



It covers the function about induction machine and synchronous machine. Rotor and stator both have magnetic field. The rotor frequency plus the turn speed of machine is equal to frequency of stator. From this machine many people realized that these two machines are related to each other by magnetic field.

Lastly, professor asked us a question. It is 60HZ on stator and rotor, what is the speed? He made an experiment to help us know. If it is the same direction, the speed is zero.

#### ***Notes***

We need to restate what Dr. Hess told to us in this meeting on Friday.

Date:03/01/2019

Time: 3: 30PM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

#### ***Agenda that was discussed:***

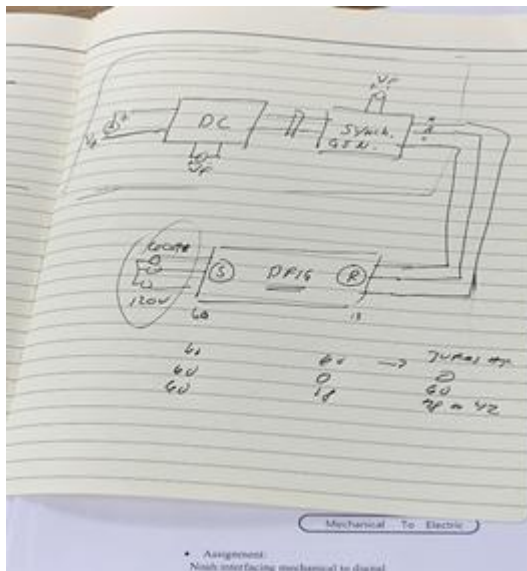
1. We want to do an experiment about voltage per hertz
2. We have some problems about the snapshot on March,5. Do we need to do the experiment on that day? If we finish the experiment, what should we show them?

3. How is the poster like? Are there just some pictures about the experiments?
4. Do we need to finish the website before that day?
5. Review the things that we did on Wednesday.

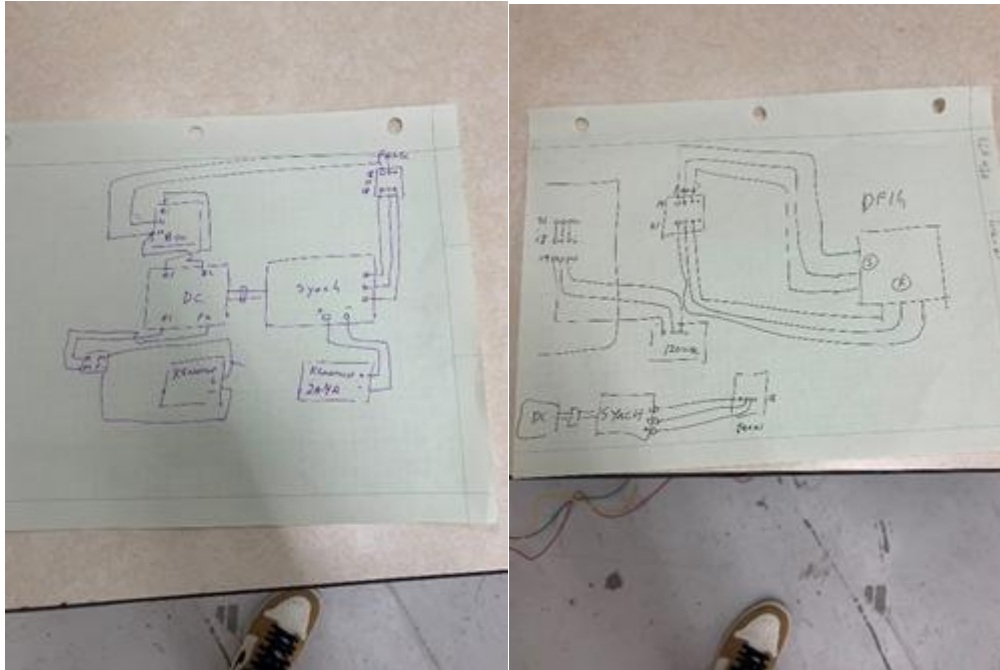
**Things we did in the lab:**

Firstly, we discussed what we should present in snapshot. How can we do to make it better? Dr. Hess told us we should present what we learned from past to this week and what we should finished for this project. Then, professor helped us to review the content about last meeting. The content is 60HZ on stator and rotor, what is the speed? If it is the same direction, the speed is zero.

Dr. Hess drew a picture to teach us doubly-fed machine. If the stator and rotor both 60HZ, the turn is zero. If one side is 60HZ the other side is 0HZ, the turn is 60HZ. If one side is 60HZ one side is 18HZ, the turn is 78HZ or 42HZ.



The last part is the most important. We do the experiment to combine the DC machine and synchronous machine. Dr. Hess drew the diagram to us.



The DC machine can control the speed. The synchronous machine can control the voltage. The current turns down the speed can be higher. The voltage increases the torque also increases.

### **Notes**

1. We should explain this experiment to Dr. Hess in the next meeting on Tuesday.
2. Prepare our snapshot on Tuesday.
3. Finish our website next week.

Date:03/06/2019

Time: 12:30PM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

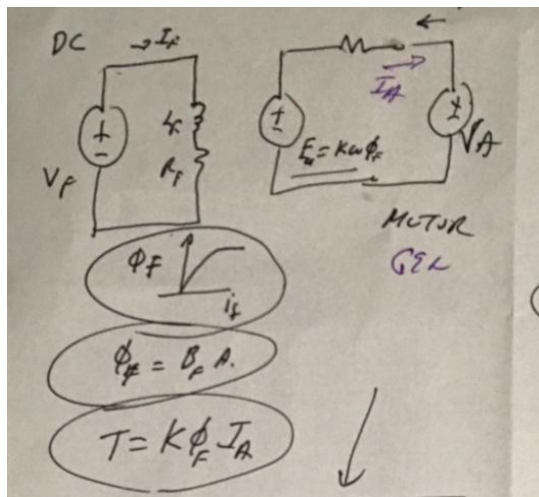
### **Agenda that was discussed:**

1. Review the experiment what we learned in the last meeting.

2. Give us more knowledge about three machines so we can speak it in snapshot better.
3. we should know more about the experiment we have learned.
4. adjust our attitude, hope we can succeed in our snapshot.

**Things we did in the meeting:**

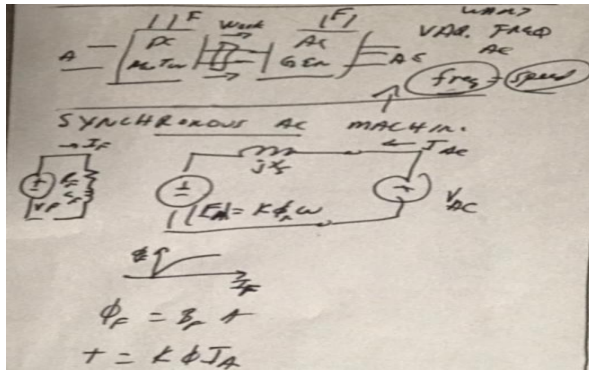
We started our meeting talking about the three types of machine that we going to work with which are DC machine, synchronous machine, and doubly fed



machine.

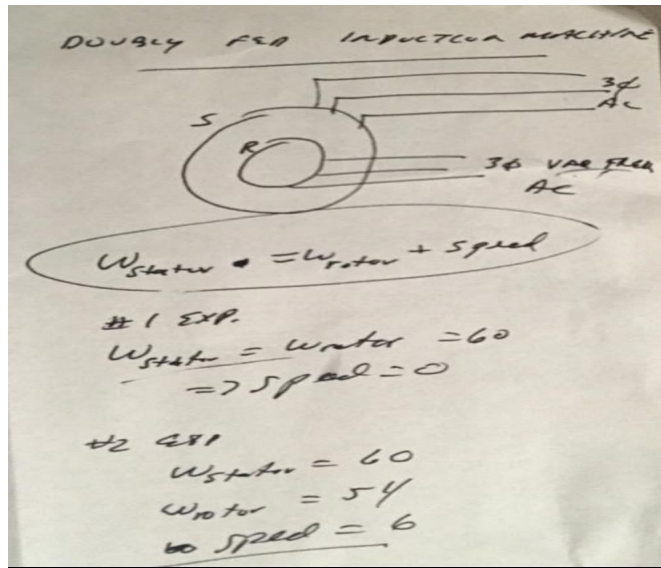
First, DC machine:

We discussed the basic concept of DC machine and how the field current can increase the magnetic field up to the point where it reaches the saturation



Second, synchronous machine:

We discussed the relationship between the frequency and speed and how the synchronous generate electrical energy



machine:

We discussed the relationship between speed,

$W_{\text{stator}}$ , and  $W_{\text{rotor}}$  as shown in the figure

We were asked if it's possible to use the same machine as motor and generator at different time. And the answer is yes because the difference between them is where you put the energy in. For example, if you put some energy into the shaft and have some way to move the shaft and you make the machine turn, it will work as generator. However, if you bring energy electrically and make the machine turn it can then move energy out mechanically. At the end we did an experiment, and that was done by connecting the AC drive to rotor by putting 60 Hz.

Other notes:

We have homework that is due next meeting (6.5)

Read sections 6.9 and 6.10

Date: 03/08/2019

Time:15:30PM

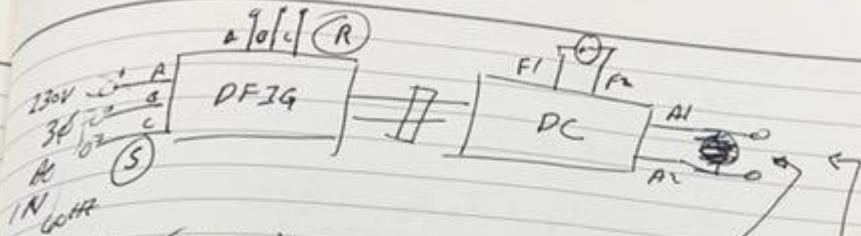
Location : Power Lab Laboratory

Attendance:Dr.Hess,Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Things that we discussed:

We started our meeting talking about how the DC machine and DFIG operate. Then, Dr. Hess gave us some questions that we need to do over spring break. These questions required us to do some reading on how the DFIG operate with DC machine. After answering the first three questions we will need to use matlab in order to simulate the circuit and get a graph that is torque vs speed





1)  $(ABC)_R \Rightarrow$  SHORT  
GET 180V DC out

2)  $(ABC)_R \Rightarrow$  50 Hz AC 3 $\phi$   
GET 20V DC out

3)  $(ABC)_R \Rightarrow$  50 Hz AC 3 $\phi$  ; your choice  
GET 120V AC, 5Hz, ~~5 $\phi$~~  Vdc...  
 What is necessary?

4) MATLAB / SIMULINK EQUAS  
~~AFIM~~ GET 17 TO WORK  
Induction Motor Torque vs Speed

Date:03/22/2019

Time:15:30PM

Location: Power Lab Laboratory

Attendance:Dr.Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Agenda that we discussed:

The questions that we left from the last meeting.



1)  $(ABC)_R \Rightarrow$  SHORT

GET 180V DC out

2)  $(ABC)_R \Rightarrow$  50 Hz AC 3φ

GET 20V DC out

3)  $(ABC)_R \Rightarrow$  50 Hz AC 3φ ;

GET 120V AC, 5 Hz

Your choice

VDC...

What is necessary?

4) MATLAB / SIMULINK

EQUAS  
MATLAB

~~DFIG~~ → GET 17 TO WORK

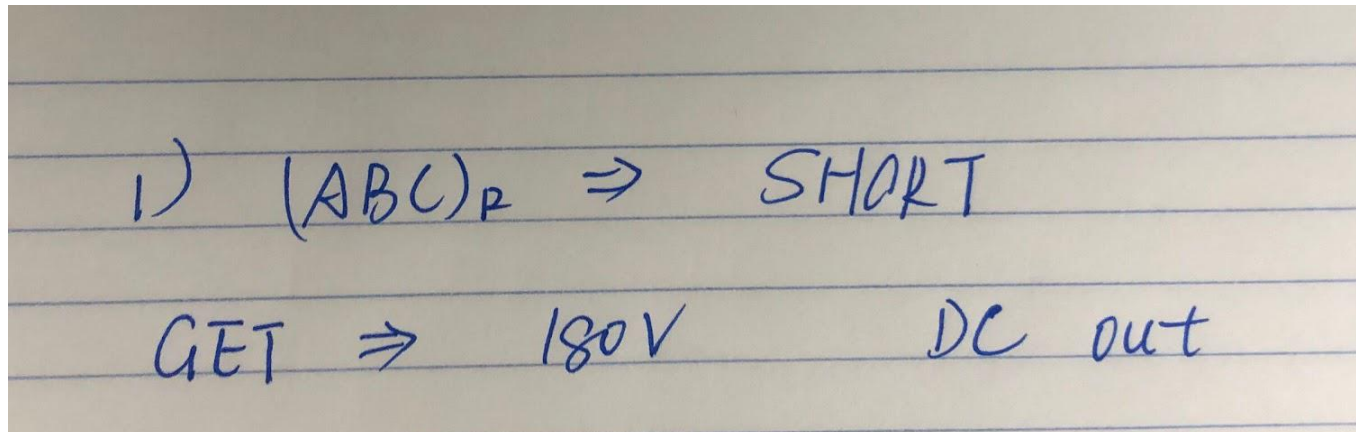
Induction Motor

Torque vs Speed

Things we did in the meeting:

We solved the problems that we left.

1. The first question:

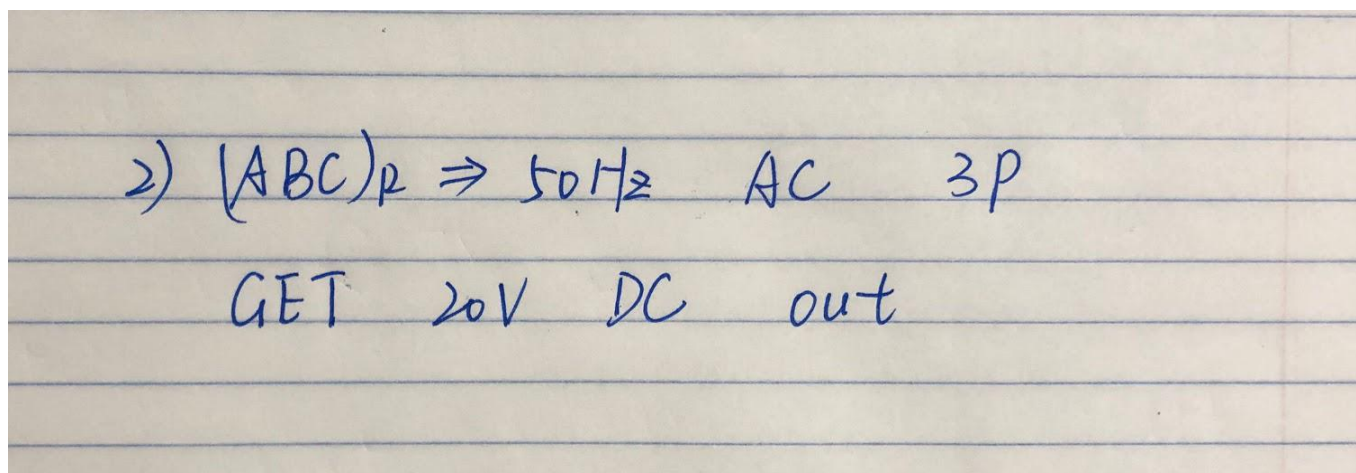


Change the flux, we can get 180V.

How could we change flux?

Increase field current.

2. The second question:

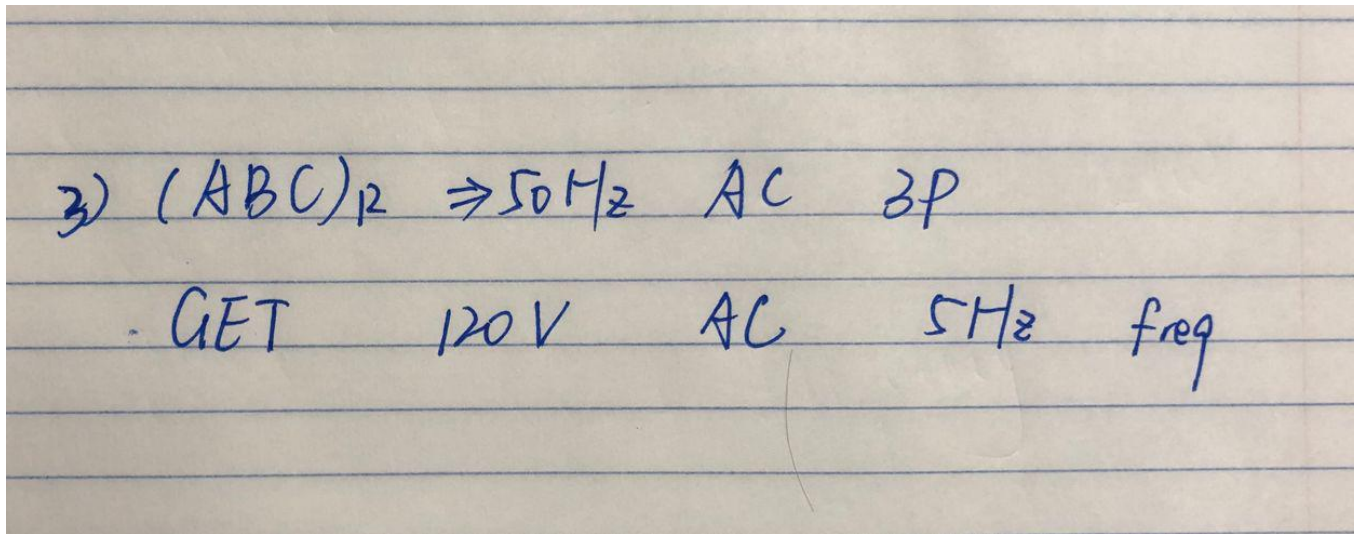


How fast of the rotate?

$60Hz - 50Hz = 10Hz$ .

$3V/Hz$  is invariant. So voltage is 30V. We have to change 30V into 20V, so that we have to decrease field current.

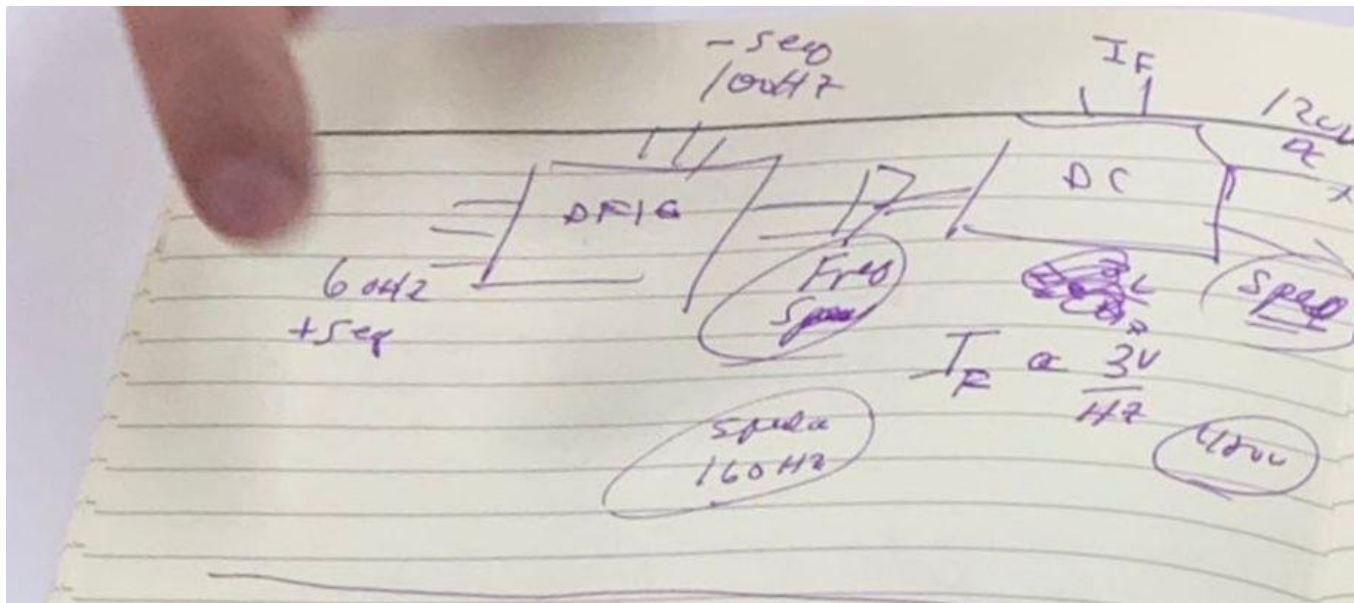
3. The third question``



The left side is 75Hz, and the right side is 50Hz

The difference between these two is 25Hz. And Field Current is equal to 3V/Hz, so the voltage of output is  $25\text{Hz} \times 3\text{V/Hz} = 75\text{V}$ .

And then Dr.Hess asked us to come up with two problems about behaviour of the machine.



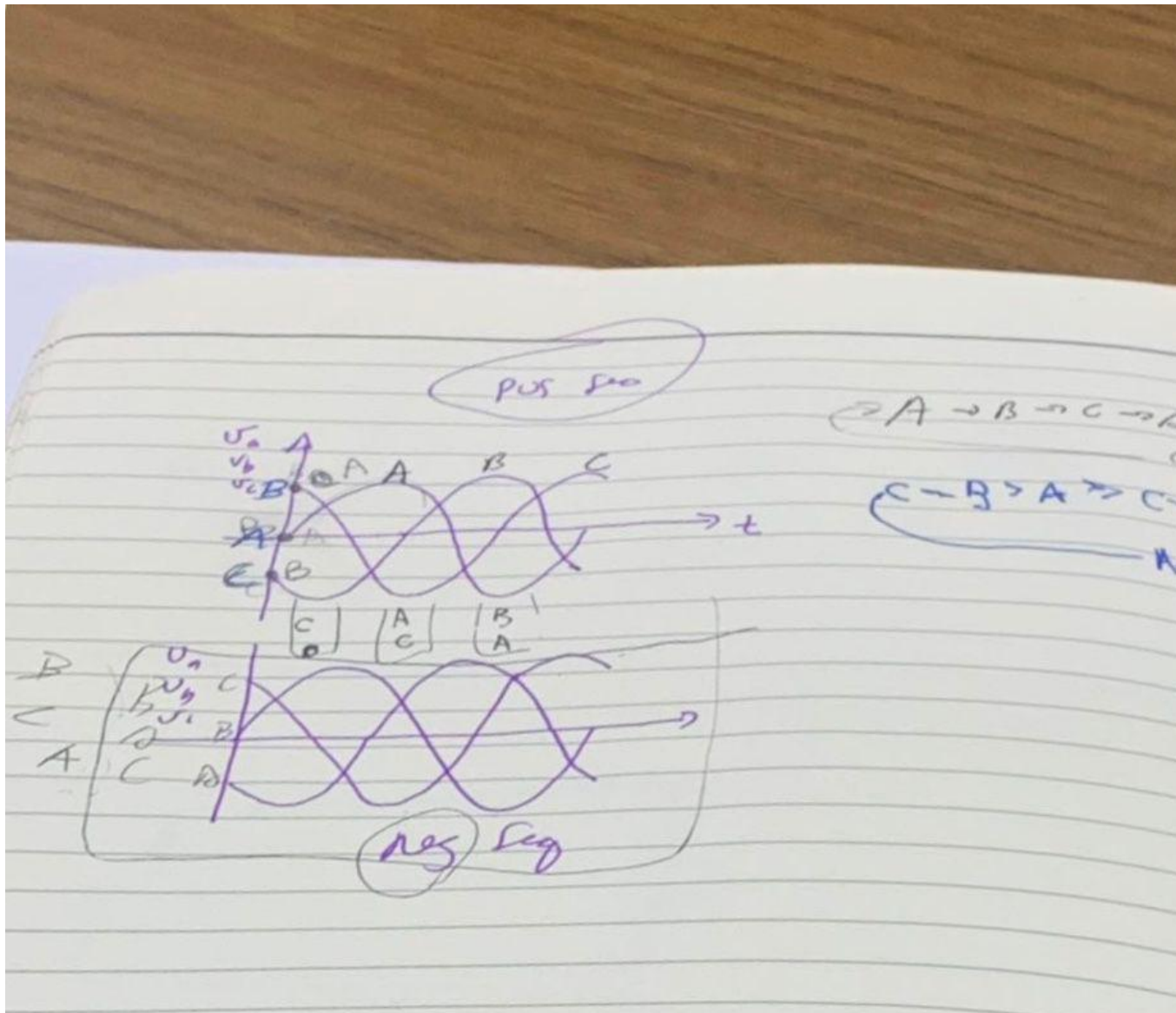
Given: 60Hz +seq, 100Hz -seq, 120V DC out, field current is 3V/Hz.

$60 - (-100) = 160\text{Hz}$     $160 \times 3 = 480\text{V}$

And at last, we have a question about what are positive sequence and negative sequence?

The sequence is one follows the other. The first one comes by called A, The second one comes by is B. So, positive sequence is A--B--C--A, negative sequence is C--B--A--C.

The first one is positive sequence, the second one is negative sequence.



Other notes:

Homework: We have to come up with two questions to each other.

Date:03/27/2019

Time: 12: 30AM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

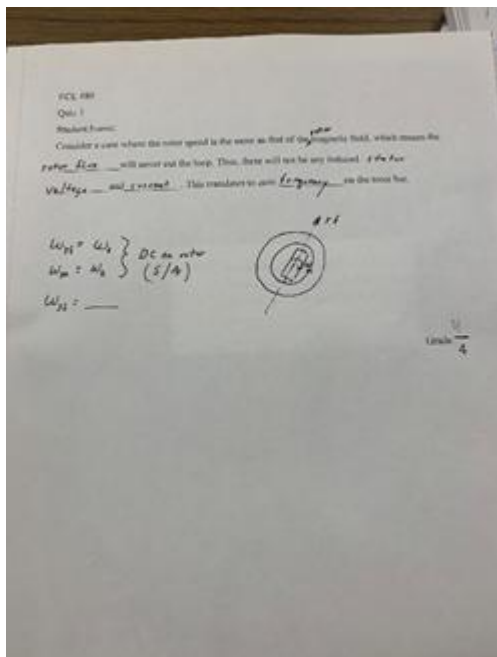
**Agenda that was discussed:**

1. The problem for our homework (everyone has two questions then ask each other).
2. Practice to do a new experiment.
3. Review the questions what we talked about last meeting.

**Agenda that was discussed:**

Firstly, we all provided our own questions and let other people to solve it.

Khalid's question is below this line in the picture.



His questions is focus on the relationship with speed on the DFIG machine and voltage on DC machine. How do change the voltage we need to change the flux. How to change the flux we need to change the field current.

My first question is about this system the stator and rotor sequence both positive. The rotor frequency is greater than stator frequency. According to the formula the

frequency of DFIG is negative. Why have this situation. Dr. Hess told me it may back around.

My second question about the voltage on DFIG machine do not have relationship with the voltage on DC machine.

Jintong's question is if the stator and rotor have the same frequency what should be the frequency in this machine. We can according to the formula what Dr. Hess told us in meeting.

Last of the meeting, Dr. Hess told us what we should do in the next meeting. We need to show the experiment to him. He also told us how to use DC machine, but the machine seems have problem.

## **Notes**

1. Review the experiment and show to Dr. Hess next meeting.

Date:03/29/2019

Time: 3: 30PM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

### ***Agenda that was discussed:***

1. Show the experiment to Dr.Hess. The experiment is the question he told us before the last meeting.
2. Practice to do a new experiment.
- 3.Review the questions what we talked about last meeting.

### ***Agenda that was discussed:***

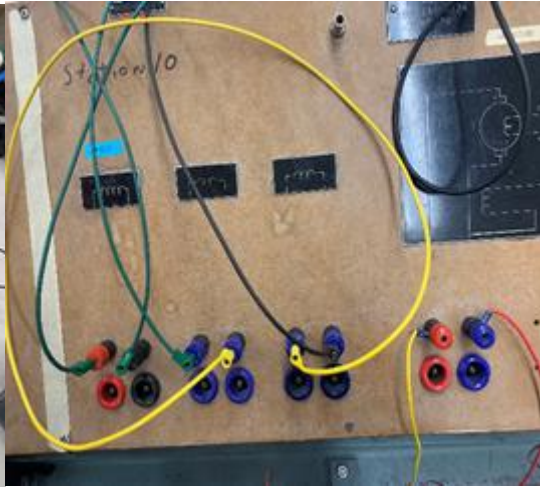
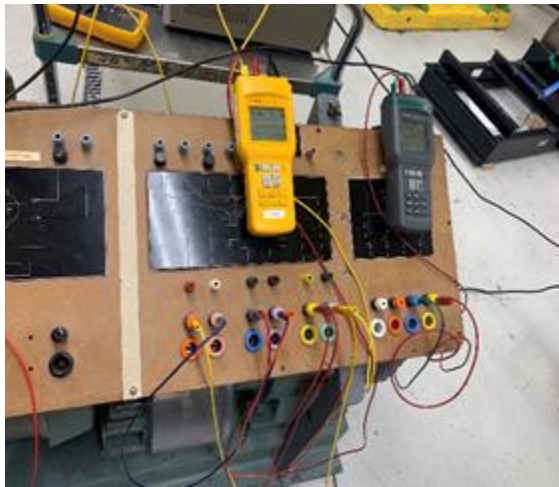
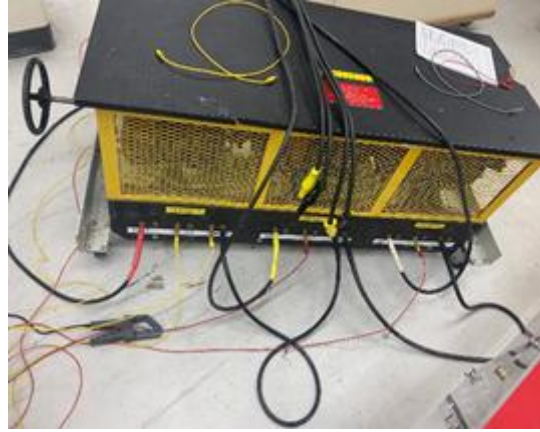
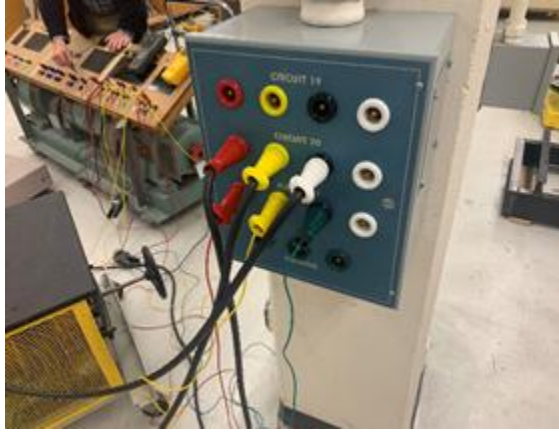
In this meeting, we use every time to do the experiment about combine DC machine and DFIG.

Firstly, we need to check whether the DC machine can be used. We can check whether the current is the same amount with the current in the nameplate.

Then we need to connect the wire to each part and make two machines connect each other.

The picture can show how to connect these electric wire.





We should connect circuit 20 to transform then to DFIG. Circuit connect to DC machine.

Later, we started the machine. We can see the machine start to rotate.

Now, we can change the number of control field and current to change the speed of the machine.

The speed changed, the frequency of the rotor also changed. We are according to the formula  $\omega_s - \omega_r = \omega_m$ . The frequency of the stator is 60Hz.

We also can make rotor to 3 phase. The frequency of rotor is 60 Hz. We can change the speed of this machine. The frequency of stator can be changed, but it must bigger than 60 Hz.

If we want to make the frequency lower than 60Hz. We need to change the direction of rotation. It also means change the direction of AC voltage. We can according to the formula and speed to know the frequency of the stator. (300rpm=1Hz)

## **Notes**

1. Writing what we saw for this experiment.

Date:04/05/2019

Time:3:30PM

Location:Power Lab Laboratory

Attendances:Dr. Hess, Yuanchen Yan, and Jintong Zhang

## **Agenda that we discussed:**

We want to do an experiment about synchronous machine.

## **Things we did in the lab:**

The experiment is about synchronous machine. We did two experiments about synchronous generator and synchronous motor.

### **Synchronous motor**

The picture shows how we connect the machine.

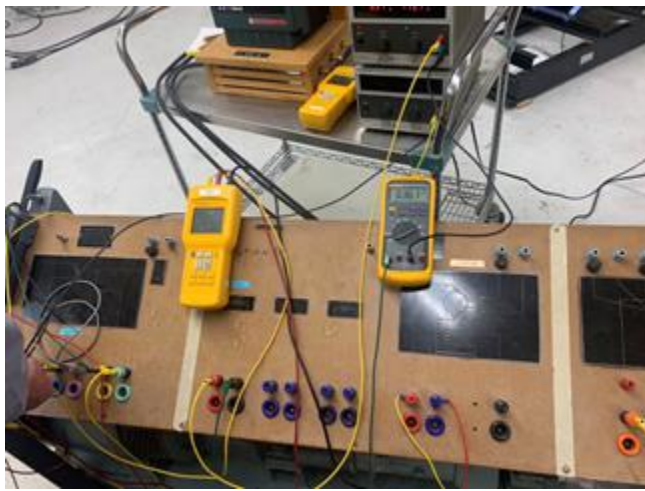


We would use AC drive which provides frequency.

If frequency increases, total voltages will increase.

The voltage of motor which equals to the voltage plus the voltage of AC drive.

### **Synchronous generator**



The picture shows how we connect synchronous. In this experiment one DC machine is needed to be connected so that we can get more field current.

How could we change the voltage?

We can change DC field current or change the field current in rotor of synchronous machine.

For example, if we want a larger voltage. We can reduce the number of DC field current or increase the field current in rotor of synchronous machine.

Date: 4/10/19

Time: 12:30PM

Location: Power lab laboratory.

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

Things we did in the lab

We went over last experiment which was about synchronous machine. First, Dr.Hess asked us how does synchronous machine work. So would say that the electrical machine can be defined as a device that converts electrical energy into mechanical energy or mechanical energy into electrical energy. An electrical generator can be

defined as an electrical machine that converts mechanical energy into electrical energy. An electrical generator typically consists of two parts; stator and rotor. There are various types of electrical generators such as direct current generators, alternating current generators, vehicular generators, human powered electrical generators. The rotating and stationary parts of an electrical machine can be called as rotor and stator respectively. The rotor or stator of electrical machines acts as a power-producing component and is called as an armature. The electromagnets or permanent magnets mounted on the stator or rotor are used to provide magnetic field of an electrical machine. The generator in which permanent magnet is used instead of coil to provide excitation field is termed as permanent magnet synchronous generator or also simply called as synchronous generator. In general, synchronous generator consists of two parts rotor and stator. The rotor part consists of field poles and stator part consists of armature conductors. The rotation of field poles in the presence of armature conductors induces an alternating voltage which results in electrical power generation. At the end, we did the experiment that we did on Friday again.

Date:04/12/2019

Time:3:30PM

Location:Power Lab Laboratory

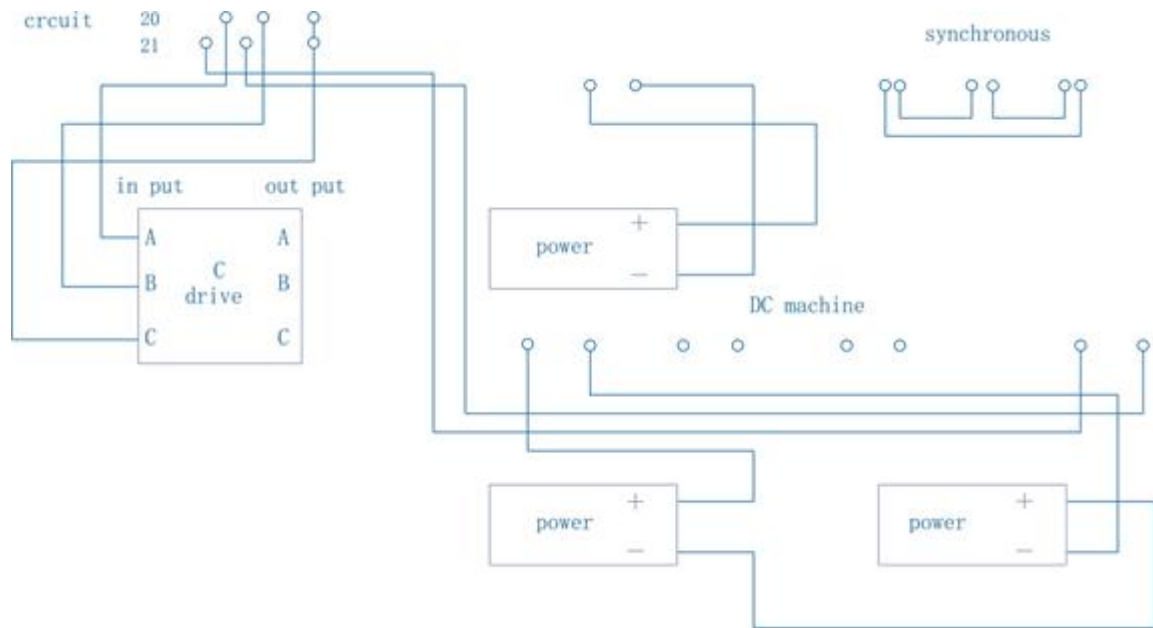
Attendances:Dr. Hess, Yuanchen Yan, and Jintong Zhang

### **Agenda that we discussed:**

We want to do experiments about synchronous generator

### **Things we did in the lab:**

#### **Synchronous generator**



Add motor to DC machine ,synchronous machine becomes synchronous generator.  
 We need to know how to change the voltage of generator.

- 3 ways to change it: (1) decrease field current of motor  
 (2) Increase field current of generator  
 (3) Increase field control

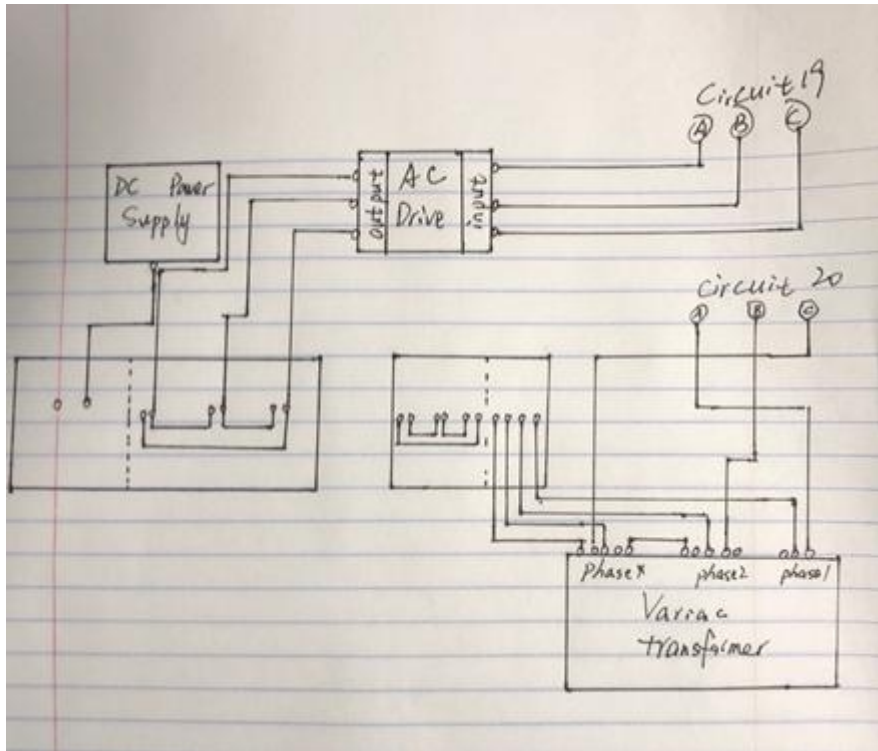
Data of the experiments:

Field Current(motor)(A)	Voltage(generator)(V)
0.8	13.5
0.73	13.8
0.55	15.3
0.41	17.5

Field Control(DC volts)(V)	Speed	Frequency	Volts(generator)
30.3	245.2	7.6	19.3
41.0	318.1	10.6	27.1
52.1	417.4	13.9	35.4
59.3	476.7	15.7	40.6
70.5	575.1	19.2	48.8
80.1	657.2	21.9	55.8

Field Current(generator)(A)	Voltage(generator)(V)
0.64	13.1
0.9	16.7
1.14	19.0
1.27	19.4
1.38	20.6

## Synchronous motor and DFIG



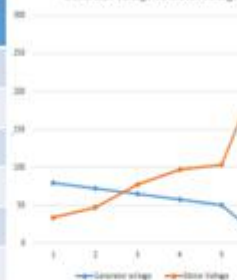
## Data of the experiment:

### Data

Synchronous motor

voltage	speed	Frequency
33.8	137.4	5
47	297	10
77	448.9	15
97	608.3	20
103	755.2	25
240	1822	60

Generator voltage VS Motor voltage



Double fed induction generator

voltage	Frequency
79.7	55
72.1	50
64.6	45
57.2	40
50.1	35
3.3	0

Frequency on the AC drive (Hz)	motor voltage (V)	Frequency on the DFIG	Generator Voltage
5	33.8		79.7
10	47		72.1
15	77		64.6
20	97		57.2
25	103		50.1
60	240		3.3
		55	79.7
		50	72.1
		45	64.6
		40	57.2
		35	50.1
		0	3.3

Frequency on the AC drive	speed
5	137.4
10	297
15	448.9
20	608.3
25	755.2
60	1822

## Notes:

### **1. Prepare for the design review.**

### **2. Take some videos for review.**

Date:04/26/2019

Time: 3: 30PM

Location: Power Lab Laboratory

Attendees: Dr. Hess, Khalid Almutairi, Yuanchen Yan, and Jintong Zhang

### ***Agenda that was discussed:***

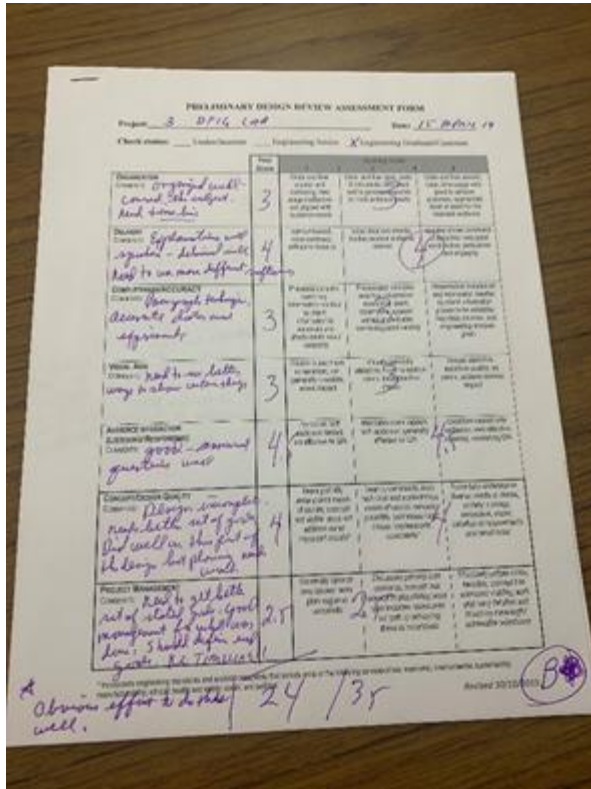
1. Talk about the design review.
2. What do we need to do in the next few weeks?
3. What's the plan for the next semester?

### ***Things we did in the lab:***

Firstly, Dr. Hess gave us some feedback about our design review.

The picture of feedback is below this line





He also gave us see other students' feedback.

Then, he let us solve a problem. If we can solve it he can help us to add some grades.

Later, he told what we should submit for next week's class. And what we should do for next semester. The things what we should submit he had sent email to us.

At last of the meeting, he asked us whether we have some questions. If we do not have any question we can finish the meeting. This is the last meeting for us.

## Notes

Next semester we will change the professor.