Sekolah Pendidikan Profesional dan Pendidikan Berterusan (SPACE)

PROGRAM KEJURTERAAN ELEKTRIK
PUSAT PENGAJIAN DIPLOMA (PPD), SPACE
UNIVERSITI TEKNOLOGI MALAYSIA
KUALA LUMPUR

MECHATRONICS ENGINEERING LABORATORY

(DDWE 3711)

ELECTRICAL MACHINE AND DRIVES

EXPERIMENT 2

THREE PHASE RECTIFIER CIRCUITS

Group members	**1.**
	2.
	3.
	4.
	5.
Lecturer	**:**
Date	**:**

No.	PO	CO	Student Marks	Marks
1	PO1	CO1		40%
2	PO2	CO3		50%
3	PO8	CO6		10%
		Total Marks		/100%

TITLE : THREE PHASE RECTIFIER CIRCUITS

OBJECTIVES;

After doing this experiment, you will be able to:

1. Construct three pulse and six pulse rectifier circuits.
2. Identify the output voltage of the three pulse and six pulse rectifier circuits.
3. Understand the function of uncontrolled and controlled rectifier circuits.

EQUIPMENTS;

1. Lab volt experimental panel
2. Power supply module (8821-2A)
3. Resistive load module (8311-0A)
4. Inductive load module (8321-0A)
5. Power diode module (8842-1A)
6. Data acquisition module (9062-15)
7. Power tyhristors module (8841-2A)
8. Firing tyrhristor unit (9030-30)
9. Desktop

COMPONENTS;

1. Wire jumper

PART A

Three-phase : Three pulse rectifier using power diode

Setting up the equipment and procedures;

1. Install the Power supply (8821-2A), resistive load (8311-0A), inductive load (8321-0A), power diode module (8842-1A), and data acquisition module (9062-15).
2. Set up the circuit of **Figure 1** using resistive load (8311-0A). *Make sure power diode set the switch **S1** on the power diodes module to the position **0**.*

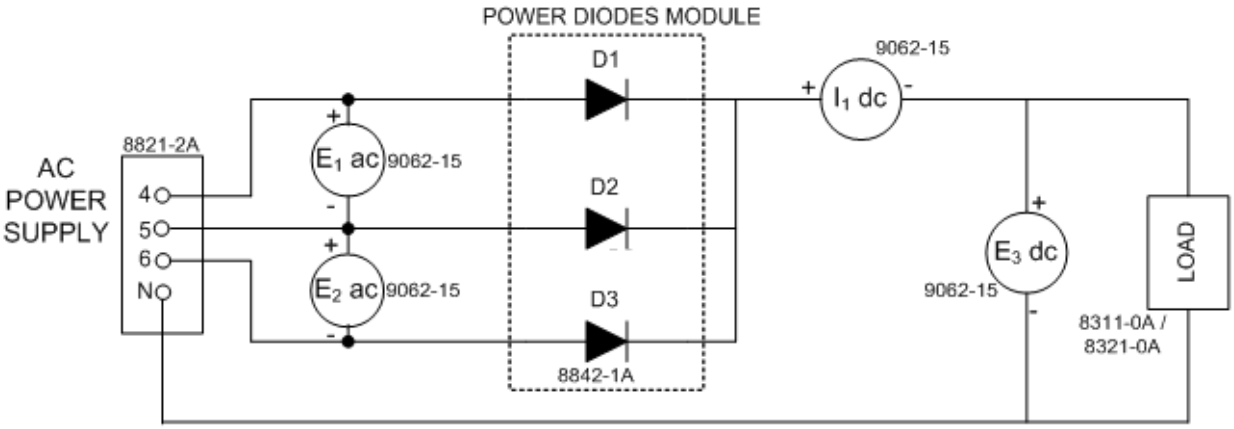

Figure 1

Note;

You will use virtual ammeter and voltmeter throughout the lab session. The lab instructor will show you how to use computer based data acquisition system.

3. Set load, **R = 2400 Ω.**
4. On the power supply, make sure that the voltage control selector is set to the **4-5** position. Switch **ON** the power supply, turn the voltage control knob so that the voltage indicated by the power supply voltmeter is **100 V**.
5. Print or save the voltage and current waveform displayed on the scope (monitor screen).
6. Record the output voltage, current and power of the rectifier in the first row of **Table 1**.
7. Set the voltage control knob to the **0** position and turn **OFF** the power supply.

8. Change the load in the circuit to the inductive load (8321-0A). Connect the resistor and inductor in series and set up the **R = 2400 Ω** and **L = 7.6 H**.

9. Switch **ON** the power supply, turn the voltage control knob so that the voltage indicated by the power supply voltmeter is **100 V**.
10. Complete the **Table 1**.
11. Set the voltage control knob to the **0** position and switch **OFF** the power supply.

Load	Output Voltage (E_3) (Volt)	Output Current (I_1) (Ampere)	Output power $Po = E_3 \times I_1$ (Watt)
1. Resistive (R=2400 Ω)			
2. Inductive (R=2400 Ω, L=7.6 H)			

Table 1

PO1	**CO1**	..... **/5m**

What is the effect of the inductive load on the operation of the circuit?

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.....

PO1	**CO1**	..... **/5m**

Compare the following characteristics of a three pulse rectifier to those of a single phase bridge rectifier in experiment 1.

Average output voltage : .....

Compare the output voltage of the circuit to the theoretical value.

Theoretical value: $E_3 = 0.675\ Es$ = ... V dc. (Es = 100 V)

Measured value : E_3 = ... V dc.

PO1	**CO1**	..... **/5m**

PART B

Three phase : Six pulse rectifier using power diode

Setting up the equipment and procedures;

1. Install the Power supply (8821-2A), resistive load (8311-0A), inductive load (8321-0A), power diode module (8842-1A), and data acquisition module (9062-15).
2. Set up the circuit of **Figure 2** using resistive load. *To simplify the connecting the power diode set the switch **S1** on the power diodes module to the position **1**.*

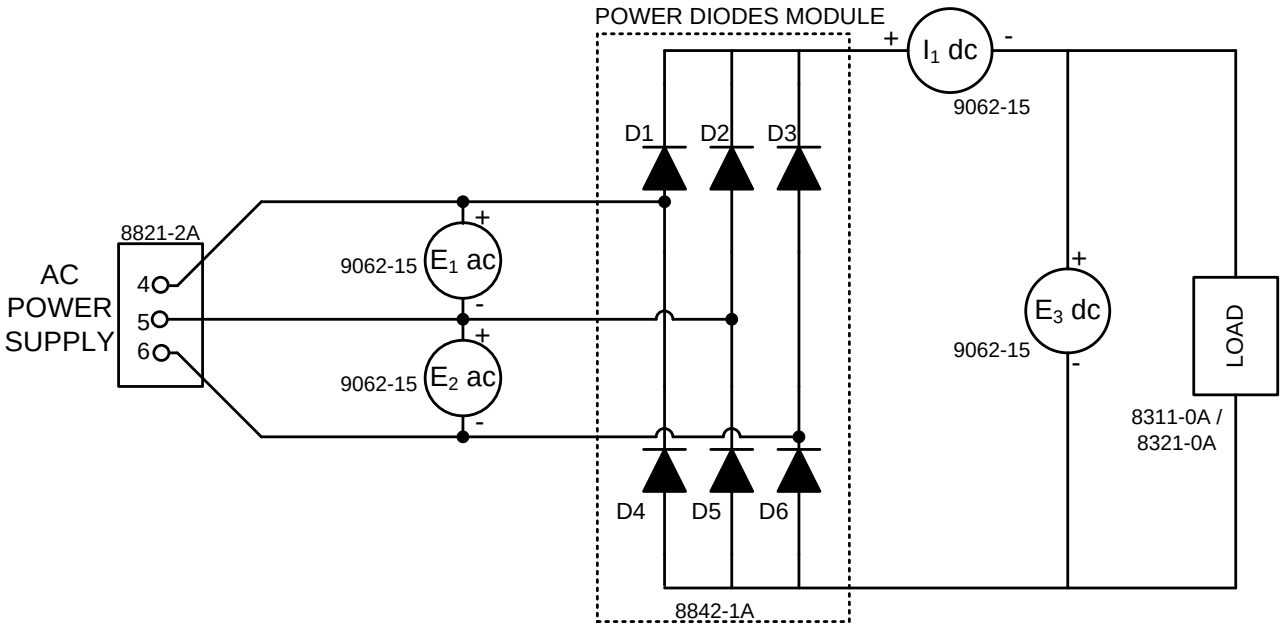

Figure 2

Note;

You will use virtual ammeter and voltmeter throughout the lab session. The lab instructor will show you how to use computer based data acquisition system.

3. Set load, **R = 2400 Ω.**
4. On the power supply, make sure that the voltage control selector is set to the **4-5** position. Switch **ON** the power supply, turn the voltage control knob so that the voltage indicated by the power supply voltmeter is **100 V**.
5. Print or save the voltage and current waveform displayed on the scope (monitor screen).
6. Record the output voltage, current and power of the rectifier in the **Table 2**.
7. Set the voltage control knob to the **0** position and turn **OFF** the power supply.

8. Change the load in the circuit to the inductive load (8321-0A). Connect the resistor and inductor in series and set up the **R = 2400 Ω** and **L = 7.6 H**.
9. Switch **ON** the power supply, turn the voltage control knob so that the voltage indicated by the power supply voltmeter is **100 V**.
10. Complete the **Table 2**.
11. Set the voltage control knob to the **0** position and switch **OFF** the power supply.

Load	Output Voltage (E_3) (Volt)	Output Current (I_1) (Ampere)	Output power $Po = E_3 \times I_1$ (Watt)	Conduction angle
1. Resistive (R=2400 Ω)				
2. Inductive (R=2400 Ω, L=7.6 H)				

Table 2

PO1	**CO1**	**…… /5m**

What is the effect of the inductive load on the operation of the circuit?

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……

PO1	**CO1**	**…… /5m**

Compare the following characteristics of a three pulse rectifier to those of a six pulse rectifier.

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……

Compare the output voltage of the circuit to the theoretical value.

Theoretical value: E_3 = 1.35 Es = …… V dc. (Es = 100 V)

Measured value : E_3 = …… V dc.

PO1	**CO1**	**…… /5m**

PART C

Three phase : Three pulse rectifier using power thyristor

1. Set up the circuit of **Figure 3**. Use a resistive load. The value of the resistor is **1200 Ω.**

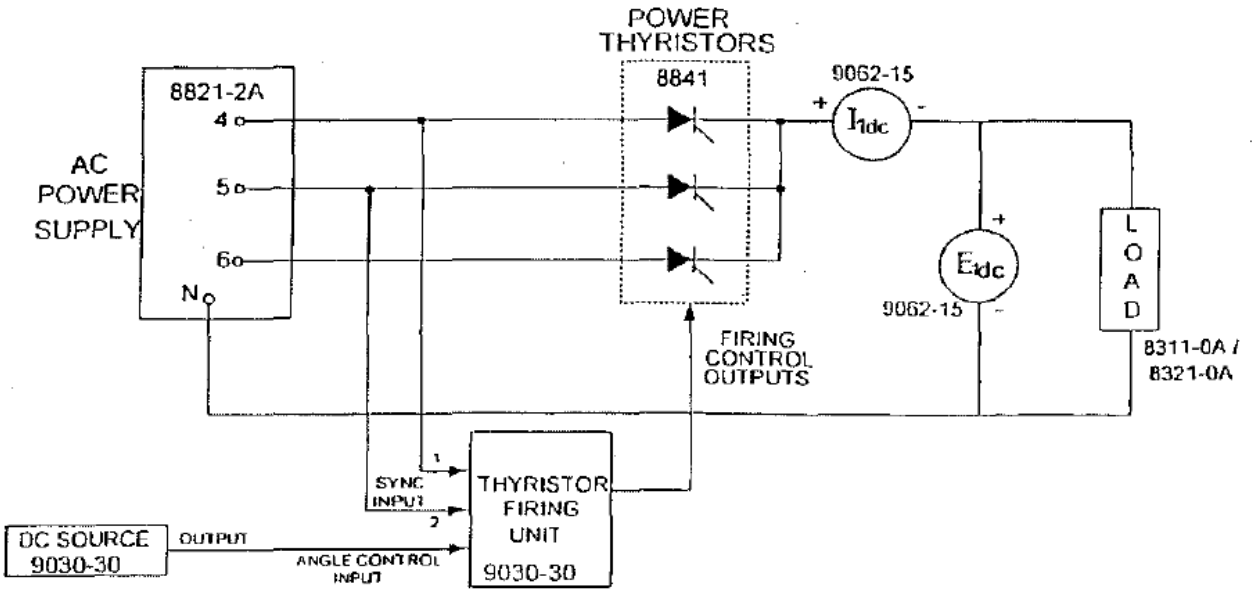

Figure 3

2. Set the main power switch to 1 (ON) and the voltage selector to **4-5** position. Vary the voltage control knob so that the voltage indicated by the power supply volt meter is equal to **100 V**.
3. Set the rocker switch of the Enclosure/Power Supply and the 24 V ac power switch to the 1(ON) position. Then, make the following settings on the **firing unit**:

ANGLE CONTROL COMPLEMENT	---- 0
ANGLE CONTROL ARC COSINE	---- 0
FIRING CONTROL MODE	---- 3~
DC SOURCE	---- MIN

4. Now, vary the firing angle and observe the waveforms.
5. Set the firing angle and record the result in **Table 3**.
6. Print or save the voltage and current waveform displayed on the scope (monitor screen) for the firing angle **0°, 40°** and **100°.** *(Please check with the instructor)*
7. After completing this experiment, please make sure you set the voltage control knob to **0** then switch off the power supply.

Firing Angle (°)	Output Voltage (E_2) (Volt)	Output Current (I_1) (Ampere)	Output power $Po = E_2 \times I_1$, W
0°			
10°			
20°			
40°			
60°			
80°			
100°			

Table 3

PO1	**CO1**	**…… /5m**

PART D

Three phase : Six pulse rectifier using power thyristor

1. Set up the circuit of **Figure 4**. Use a resistive load. The value of the resistor is **1200 Ω.**

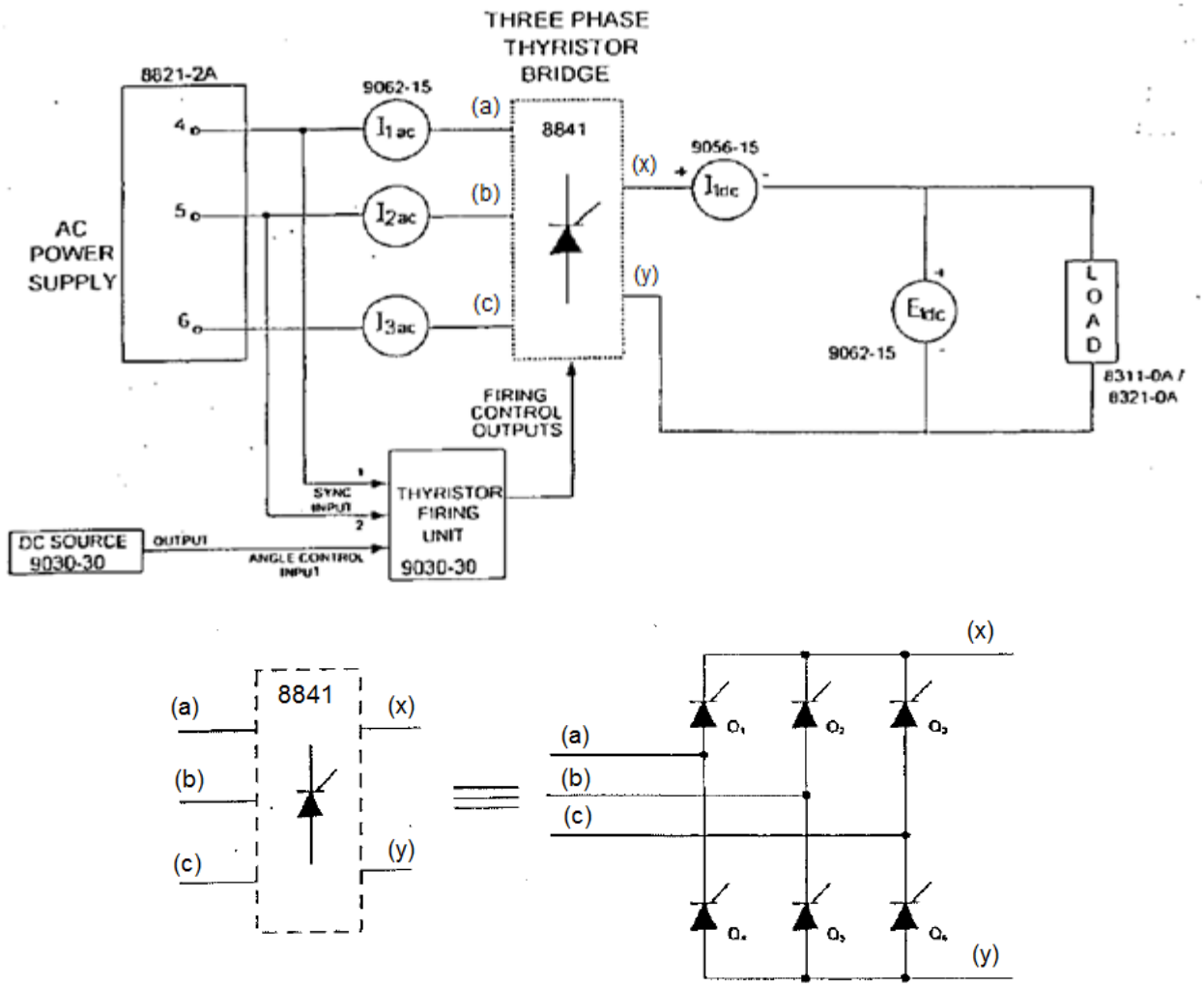

Figure 4

2. Set the main power switch to 1 (ON) and the voltage selector to **4-5** position. Vary the voltage control knob so that the voltage indicated by the power supply volt meter is equal to **100 V**.
3. Set the rocker switch of the Enclosure/Power Supply and the 24 V ac power switch to the 1(ON) position. Then, make the following settings on the **firing unit**:

ANGLE CONTROL COMPLEMENT	---- 0
ANGLE CONTROL ARC COSINE	---- 0
FIRING CONTROL MODE	---- 3~

DC SOURCE ---- MIN

4. Now, vary the firing angle and observe the waveforms.
5. Set the firing angle and record the result in **Table 4**.
6. Print or save the voltage and current waveform displayed on the scope (monitor screen) for the firing angle **0°, 40°** and **100°.** *(Please check with the instructor)*
7. After completing this experiment, please make sure you set the voltage control knob to **0** then switch **off** the power supply.

Firing Angle (°)	Output Voltage (E_2) (Volt)	Output Current (I_1) (Ampere)	Output power $Po = E_2 \times I_1$, W
0°			
10°			
20°			
40°			
60°			
80°			
100°			

Table 4

PO1	CO1	..... /5m

From your observation, what is the relationship between firing angle and output voltage.

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PO1	CO1	..... /5m

CONCLUSIONS

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PO1	CO1	..... /5m

Review Questions

1. What is the diode conduction angle in a three pulse rectifier if firing angle set to 0°?

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2. What is the average output voltage of a three pulse rectifier operating on a line to line voltage of 415 V?

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3. What is the average output voltage of a six pulse rectifier operating on a line to line voltage of 100 V?

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4. What are the advantages of a three phase rectifier over a single phase rectifier?

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5. What are the advantages of a six pulse rectifier over of a three pulse rectifier?

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PO1	**CO1**	**..... /5m**

TOTAL MARKS (PO1, CO1) = ... / 55 marks