The University of Hong Kong

Department of Mechanical Engineering

Engineering Training

Student Training Report

2023 - 2024

Curriculum: BEng in MECH

Name: Zhao Zehui

University No.: 3036064052

Student Group: ME1

Introduction

This Engineering Training Student Report is the formal record of the workshop training undertaken by the Mechanical Engineering in the Engineering Training course organized by the Department of Mechanical Engineering of The University of Hong Kong. The relevant course codes refer to MECH2418 in the University system.

The training report should cover all the activities that have been attended by the students, including workshop training modules, seminars or any other training that are related to this course. Students are required to keep relevant materials including log sheets, quizzes and all other relevant materials inside the report. No need to include handouts in the report.

The training report should be submitted in hardcopy to the General Office of the Department of Mechanical Engineering, 7/F, Haking Wong Building before the deadline as shown below. Failure to do so will result in a FAIL grade in the Engineering Training course. After the assessment, the training report can be collected from General Office within SIX months. If you have not come to collect, we will dispose the training report. This training report should be kept by student as evidence of the training that has been undertaken. This may serve as the record of the engineering workshop training which is a requirement to satisfy the Professional Requirement for Corporate Membership of the Hong Kong Institution of Engineers (HKIE).

Contents of the Training Report

The contents of the Training Report should include the following:

Cover Page that includes the curriculum, name, university number and training group of the student

This introductory page

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Summary and Self-evaluation of the whole Engineering Training

List of Training Modules and Assessment Form

Individual training modules including but not limited to:

Training log sheet

Summary of Training

print screen of CAD training (Please add as Figures in the training report.)

Pictures taken during the training (Please add as Figures in the training report.)

Individual Seminars

Summary of seminar

Worksheet, handouts, PowerPoint slide should NOT attach to this report. If certain figures, tables and sections of the worksheet is needed to be cited in the report, you should scan those parts and paste them in the training reports as figures. The template in MS Word format in Moodle page should be referred in the operation of the figures in your report.
Only type written training log sheets and Summary of Training or Seminar are allowed, and only double-sided printing will be accepted.

Language
The training report should be written in English with consistency in the use of the language throughout the report.

Submission Deadline
The submission deadline for this Training Report is **2 Aug, 2024 (Friday) at 12:30pm** to the General Office of the Department of Mechanical Engineering, 7/F Haking Wong Building.
The Training Report should be ring-bind with transparent cover showing the Cover Page as the first page of the report.

Table of Content

List of Figures

Summary and Self-evaluation of Training

Name: Zhao Zehui University No.: 3036064052

This training course runs from 27 May to 28 June in a duration of six weeks. It covers topics of Automation and Instrumentation practice which provides us experience in data acquisition, post-processing and programmable logic control; workbench practice which required us to make metal objects using engineering tools; electrical engineering practice which gives us a deeper understanding on the use of electric devices and the circuit-building experience for household circuit; machine practice which trained us for accurate measurement and observation of the product; and CAD/CAM session which allows us to get more familiarise with computer-aided design.

Nonetheless, out of all these fruitful experiences and knowledge I have gained, the priority we should all focus on is the assurance of safety and the creation of a comfortable and reliable environment for colleagues and students in school and workplace. The training course consistently reminds me of the importance of safety measurements in laboratory and workplaces as well as our responsibilities in this section. Not only did I gain more inspirations and expectations on different engineering jobs choices I would be able to experience in the future, but I have deeply recognized severe consequences of not following safety procedures which may lead to unreversible damages and injuries, such as death of a living person.

The seminars about marine engineering and floating unit of oil and gas production also gives me new insights in this industry, as relevant information about marine engineering is not common to be heard in daily life. Once again, after attending this training course, it makes me reflect on my future planning for career path and motivates me to learn more about the things that have been discussed and introduced in this course. I have a more solid understanding of the contents of various engineering fields which surely provides me guidance on the sector I would like to specialize in, and become an engineer emphasizing in engineering integrity, professionalism and responsibility.

Training Assessment Form

Training Period:	Training Module : Automation and Instrumentation
Comment	
Assessment Result : Pass / Fail	Initial of Assessor
Training Period:	Training Module : Workbench Practice (WP)
Comment	
Assessment Result : Pass / Fail	Initial of Assessor
Training Period:	Training Module : Basic Electrical Engineering
Comment	
Assessment Result : Pass / Fail	Initial of Assessor
Training Period:	Training Module : Machinery Practice
Comment	
Assessment Result : Pass / Fail	Initial of Assessor
Training Period:	Training Module : CAD/CAM
Comment	
Assessment Result : Pass / Fail	Initial of Assessor

Seminars

Date	Seminar Topic	Assessment (Pass / Fail)	Initial of Assessor
		Pass / Fail	
		Pass / Fail	
		Pass / Fail	
		Pass / Fail	
		Pass / Fail	

Overall Assessment

Comments:
Assessment: PASS / FAIL

Training Module: Automation and Instrumentation

Training Module:	Automation and Instrumentation	Student Group Attended:	ME1
Training periods	From 27May 2024 to 31May 2024		

Training Activity on Day 1, on 27May 2024

On the first two days of the Automation & Instrumentation training, we were introduced with the use of LabVIEW for data acquisition. Data acquisition is a term that means getting the data that you need. We also use different equipment for data acquisition. When using such equipment, the readings have to be taken down manually before calculations can be performed and graphs can be plotted. This can be termed as manual data acquisition.

There are newer equipment that allows communication with computers for data acquisition. Further development of data acquisition techniques makes use of the fast computation speed of computers to make virtual instruments which are not physics instruments like an oscilloscope but require users to design hoe the data should be presented and how the data is to be processed.

We were divided into five groups with four students in each group. I was given hands-on experience in using data acquisition hardware, a computer with a data acquisition board (PCI-6251) installed in it, and a software “LabVIEW” for programming my own virtual instrument. The data acquisition board converts the input signal to digital form so that the computer can read the signal. LabVIEW is the software developed by National Instruments for programming virtual instruments.

The training sessions are all conducted in COBLG112 and the instructors are Samantha and Mr Tsang.

Comment from Assessor

Exercise 1 Simulated Signal – Display waveform graph

During exercise 1, we learnt how to find and run a display waveform graph. First, we start by clicking View and selecting Controls Palette in the Front Panel. The Controls Palette can be displayed by right-clicking on a blank space in the Front Panel. Next, on the Controls Palette, we click on Graph Indicators from Express palette and then choose Waveform Graph. Graph Indicators can also be found from Modern palette. Then, a waveform graph appears on the Front Panel, and an icon appears in the Block Diagram. Move the icon to the right of the Signal Simulator. Finally, we move the cursor to the "Sine" output of the Signal Simulator and the symbol of a Wiring Tool appears. Link the Sine output to the Waveform Graph and click on the Run button.

The next task in this exercise is to record the duration of the displayed waveform and the number of cycles displayed. The duration is 0.1 second and the number of cycles is 1. In the Signal Simulator, the Sampling Rate is 1000 samples per second and 100 samples are taken. Therefore, the equation to find the duration of the sampling period is:

(100 samples) / (1000 samples per second) = 0.1 second.

To record different values, we begin with right-click on the Signal Simulator, then click on Properties. Change the frequency to each of the following, close the Properties window and run the VI.

Frequency	20Hz	40Hz	5Hz
Duration	0.1	0.1	0.1
Number of cycles	2	4	0.5

Now, in the Properties of Signal Simulator, we change the frequency back to 10Hz, Sampling Rate to 2000 samples per second and the number of samples to 500. (Uncheck the "Automatic" box.) In automatic mode, LabVIEW automatically makes the number of samples 1/10 of the sampling rate. Then run the VI. The duration on the Waveform Graph is 0.25 second. Next, change the sampling rate to 1000 samples per second and take 500 samples. Run the VI. The duration on the Waveform Graph is 0.5 second.

Comment from Assessor

Exercise 2 Simulated signal – entering the frequency from Block Diagram

In this task, we learnt to enter the frequency from Block Diagram. First, from the Properties of the Signal Simulator, change the sampling rate and number of samples to 1000 and 100 respectively. Then, we move the cursor over the double downward arrow of the Signal Simulator icon. Drag downwards to show the various items in the icon. Move the cursor on the terminal of "Frequency" and right click when it changes to the Wiring Tool. Finally, on the pop-up menu, click on "Create" and then select "Constant". A box that is linked to the terminal of the Frequency input appears.

We change the constant input value and check the frequency, then run the VI and record the period and frequency shown in the graph.

Data recorded:

Constant input	10	20
Period of displayed waveform	0.1 second	0.05 second
Frequency	10Hz	20Hz

Exercise 3 Input from the Front Panel

Other than simply changing the value in constant input and the Properties of the Signal Simulator, a further improved method is introduced in exercise 3, which is to use a frequency knob. We modified the program by replacing the constant input to Frequency and linked with a Frequency knob. There is also a numeric indicator to show value of the frequency. However, the value on the chart does not change as the knob is turned. It only changes when the program is stopped and the knob is turned before we clicks run. To make the waveform graph and numeric indicator respond to the turning of the frequency knob when the program is running, we have to include a while loop.

Exercise 4 While loop

In experiment 4, to make the waveform graph and numeric indicator (which we made in experiment 3) respond to the turning of the frequency knob, we have to add a While loop. We begin with right-click on the Block Diagram. Select While loop from "Express>>Exec Control" tab. Another option is to choose While loop from Structures under Programming Palette, and add a control to the loop condition manually.

Comment from Assessor

Then, we can see the shape of the cursor is different now. Hold down the left mouse button on the upper left-hand corner and drag the rectangle to enclose the four icons. A stop button also appears to stop the while loop.

Finally, we change the frequency by turning the frequency knob and record the value of the observed period.

	Reading 1	Reading 2	Reading 3
Observed period (second)	0.0936 second	0.05 second	0.06513 second
Indicated frequency (Hz)	10.6828Hz	20Hz	15.3535Hz

Exercise 5 Amplitude Input and waveform display settings

In previous exercise 3, we added a frequency knob for changing the value of frequency. In this exercise, we put in an Amplitude knob in the Front Panel and set its range to 0 to 1, and also an Amplitude indicator. Then, we place these two new icons inside the while loop of the block Diagram and wire them up properly. Now, we can run the VI and change the frequency knob and Amplitude knob to observe the scale of the y-axis.

The scale of the y-axis scales automatically to facilitate maximum use of the y-axis. However, to compare different waveforms, we have to fix the scale of the y-axis so that it matches with the range on the Amplitude knob. To do so, right-click on the Waveform graph. Then click on Scales under the Properties. For Amplitude (Y-Axis), we can uncheck the Autoscale, and modify the minimum value to -1 and the maximum to 1.

Moreover, we can also add inputs from the Front Panel to change the added noise. Looking back on exercise 1 to 5, we have learnt to use a Signal Simulator to provide us with a pre-defined signal. In addition, we can use “Simulate Arbitrary Signal” simulator to set our own signal according to our preferences.

Comment from Assessor

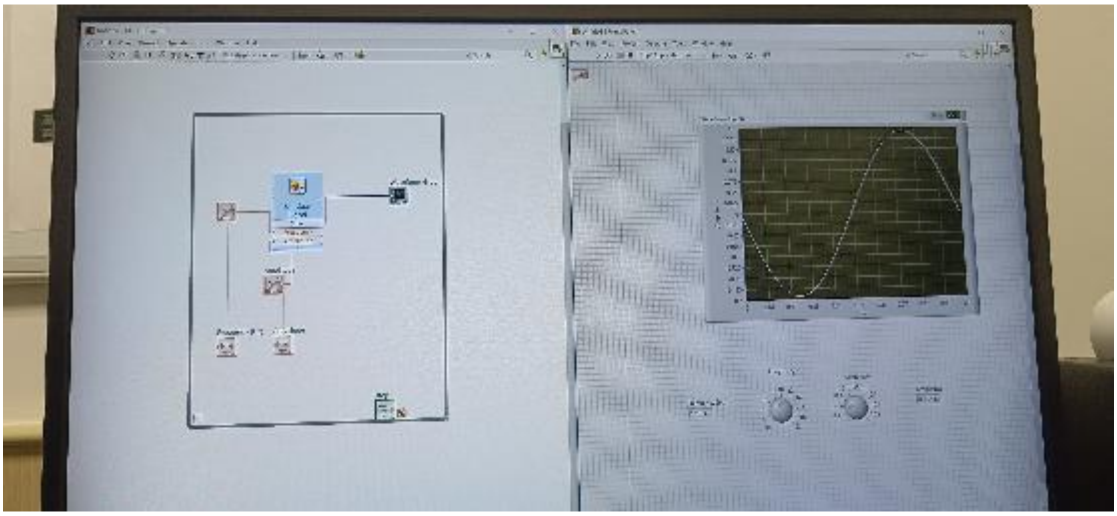


Figure 1 Waveform display settings for exercise 1-5

Exercise 6 Temperature Input

We use BNC2120 data block and plugged it into the data acquisition board fitted in the computer.

We begin with putting in a Data Acquisition Assistant from the Functions Palette in the Block Diagram. We check on the BNC-2120 that analog input channel 0 is switched to Temp Ref. Then, we multiply the magnitude of the voltage from the temperature sensor of channel 0 by 100 to get a value that is equal to the temperature in degree Celsius. Then, we display a Thermometer on the Front Panel and connect it to a temperature display. Finally, we change it to a digital display, put a While loop to enclose the icons and run the VI.

Figure 2 Data acquisition board

By pressing and removing our finger on and from the temperature sensor, we can see the value of the temperature goes up and down. We also tried adding a Meter , a Gauge, a Tank and a Graduation Bar for attempts.

Comment from Assessor

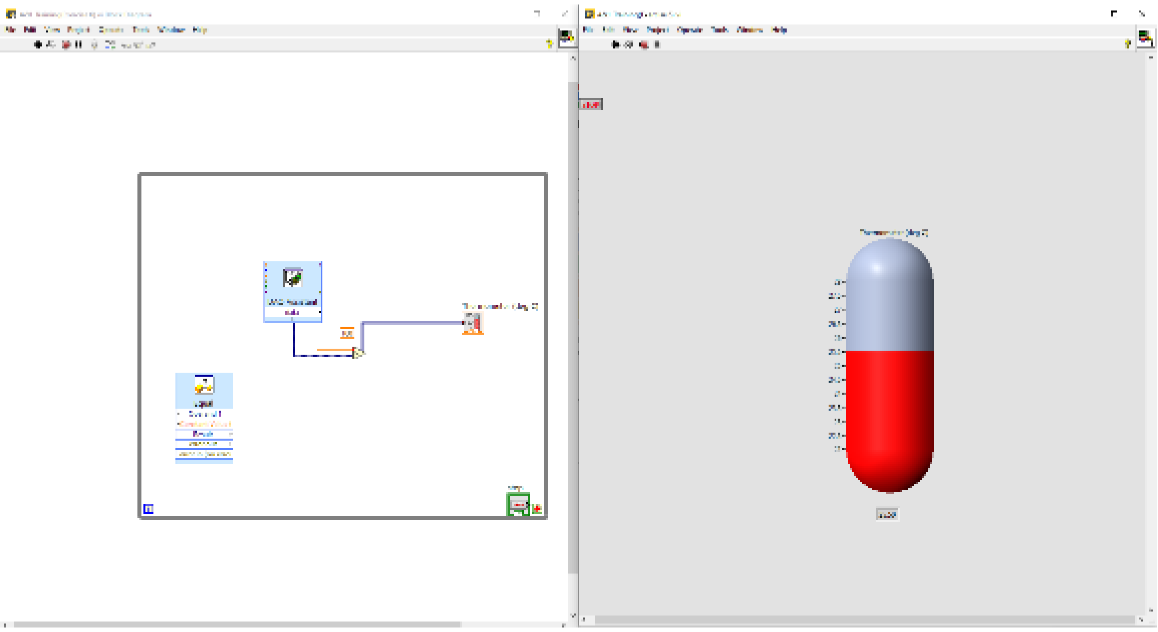


Figure 3 Exercise 6 temperature input

Exercise 7 Change to K-type thermocouple

BNC2120 is an Accessory of the data acquisition card. On the card, the connector of the K-type thermocouple is inserted to the thermocouple input of the BNC 2120, and its input goes to Channel 1. Then we hold the thermocouple junction using our thumb and first finger and observe the response on the thermometer display.

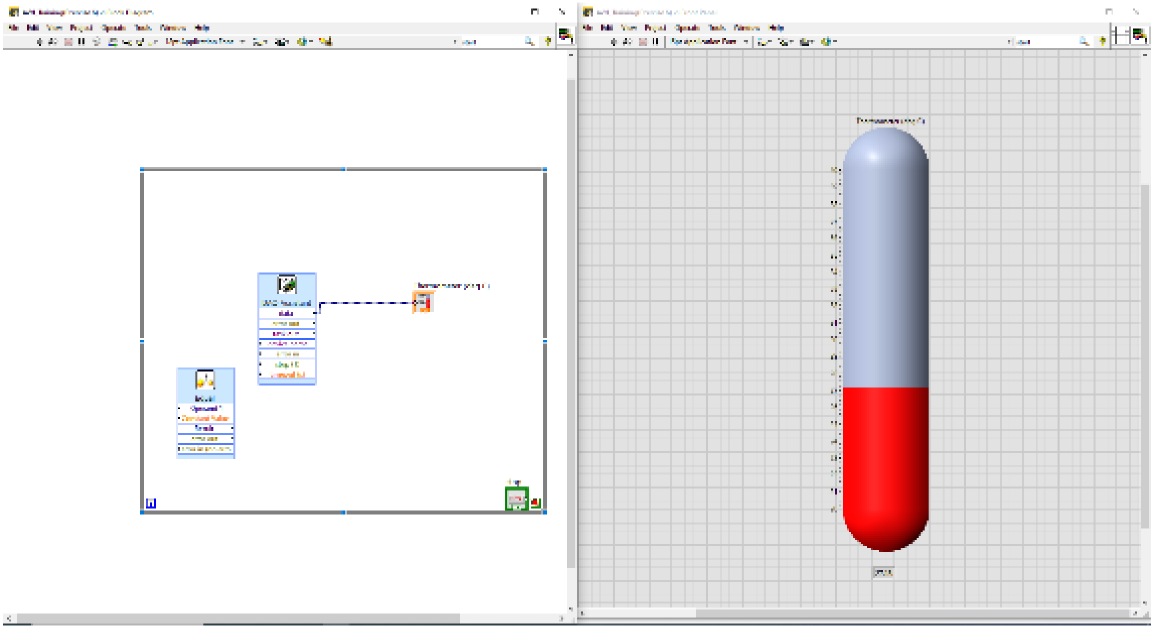


Figure 4 Exercise 7 K-type thermocouple

Comment from Assessor

Exercise 8 Create a sub-VI

The icon of the VI can be edited into a new style of our preference. The terminal of the icon is connected to the temperature input, so that the colour of the connector pane changes with the colour of the thermometer.

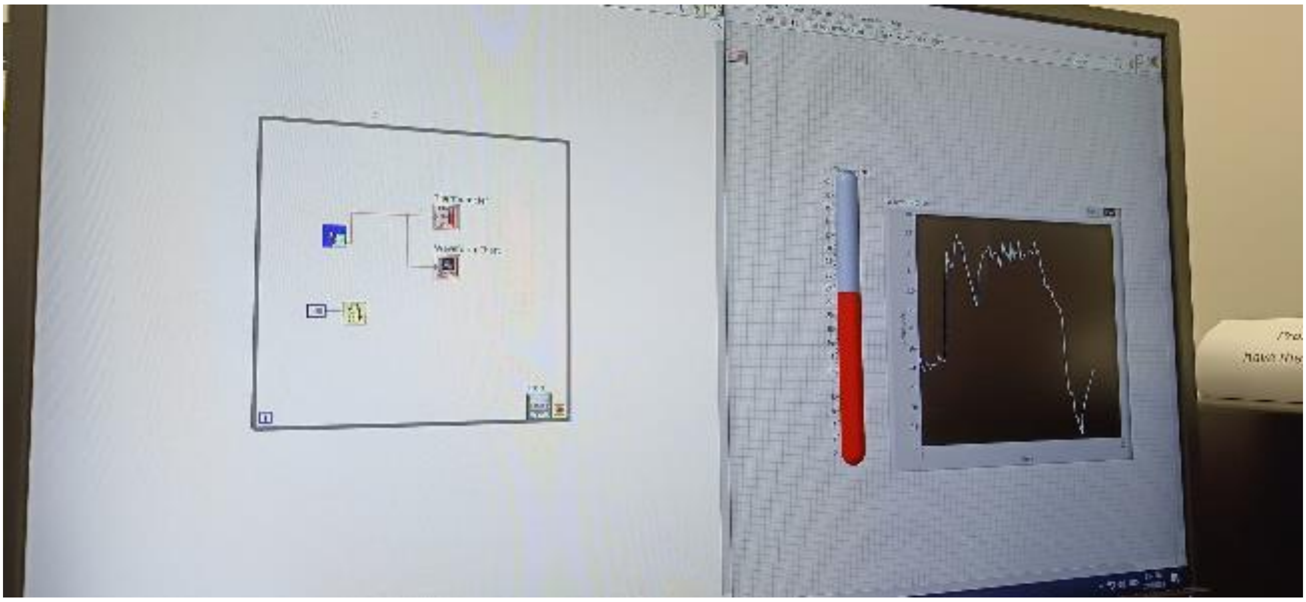


Figure 5 VI icon

Exercise 9 Temperature measurement, with Upper and Lower warning limits

In this exercise, we aim to investigate the usage of different LabView tools, including

(a) Comparison function,

(b) Constant input for Comparison,

(c) Front panel input for Comparison values,

(d) LED indicators for warning,

(e) Multiple plots on waveform chart (Bundling of data), and

(f) Counting the number of instances of temperature exceeding lower and upper limits. To attempt usage (f) more efficiently, we use Shift Registers and Case structure to store data in the previous steps and iterations.

Comment from Assessor

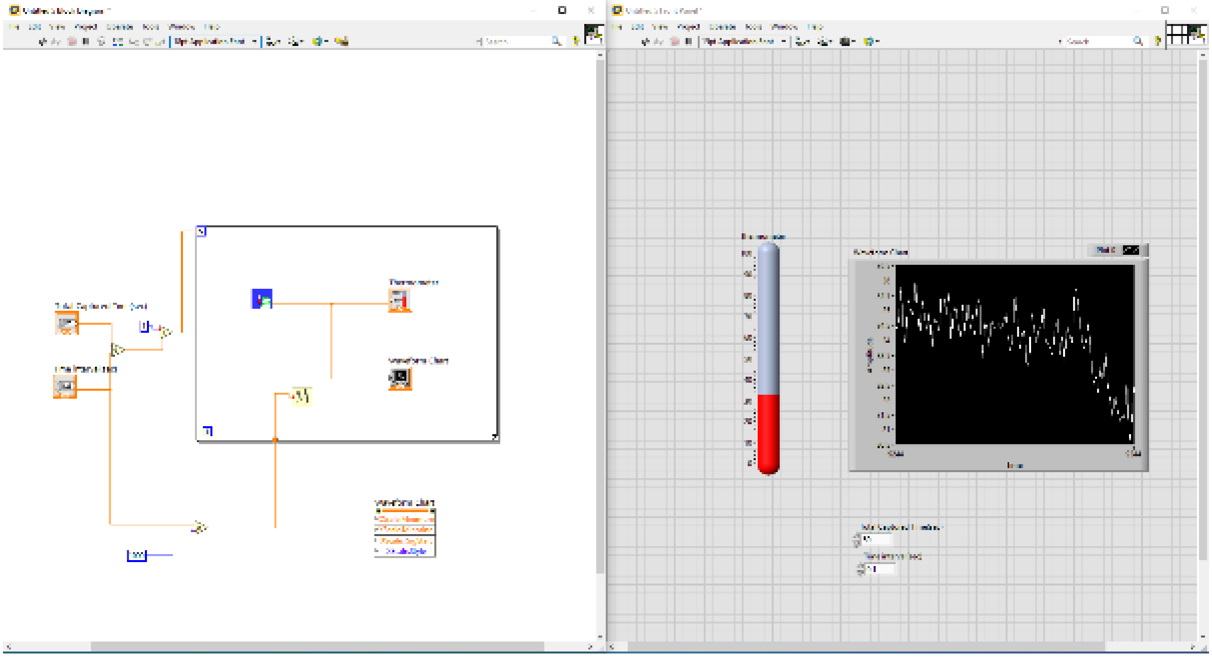


Figure 6 Exercise 9a

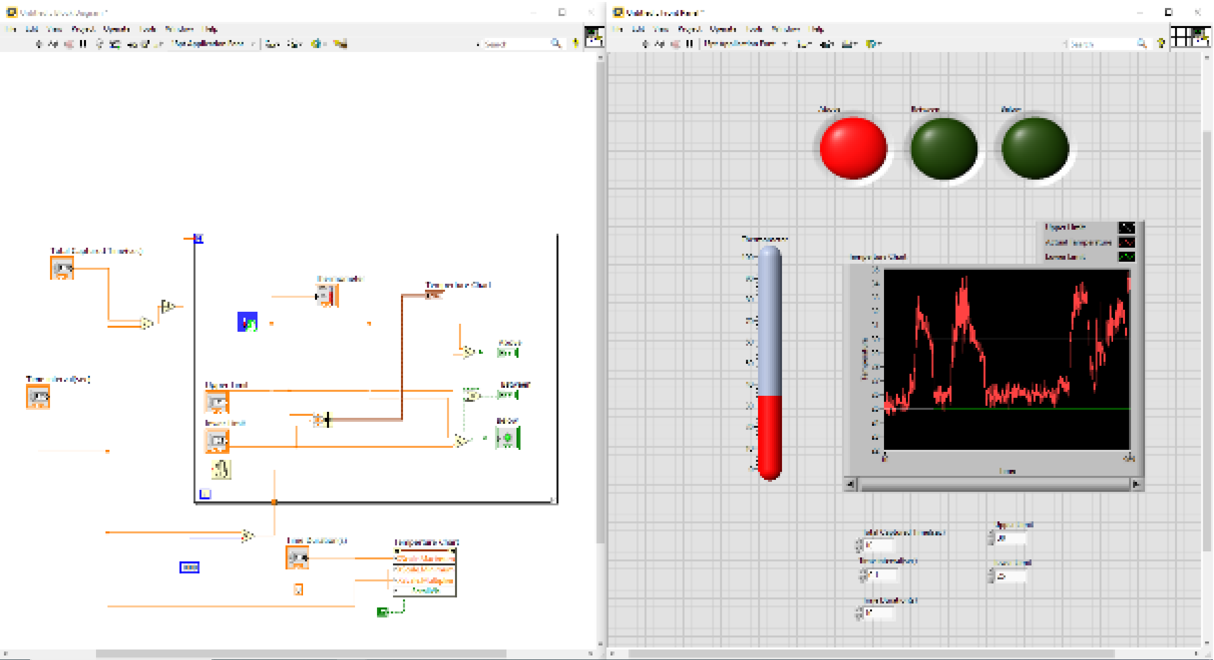


Figure 7 Exercise 9c

Comment from Assessor

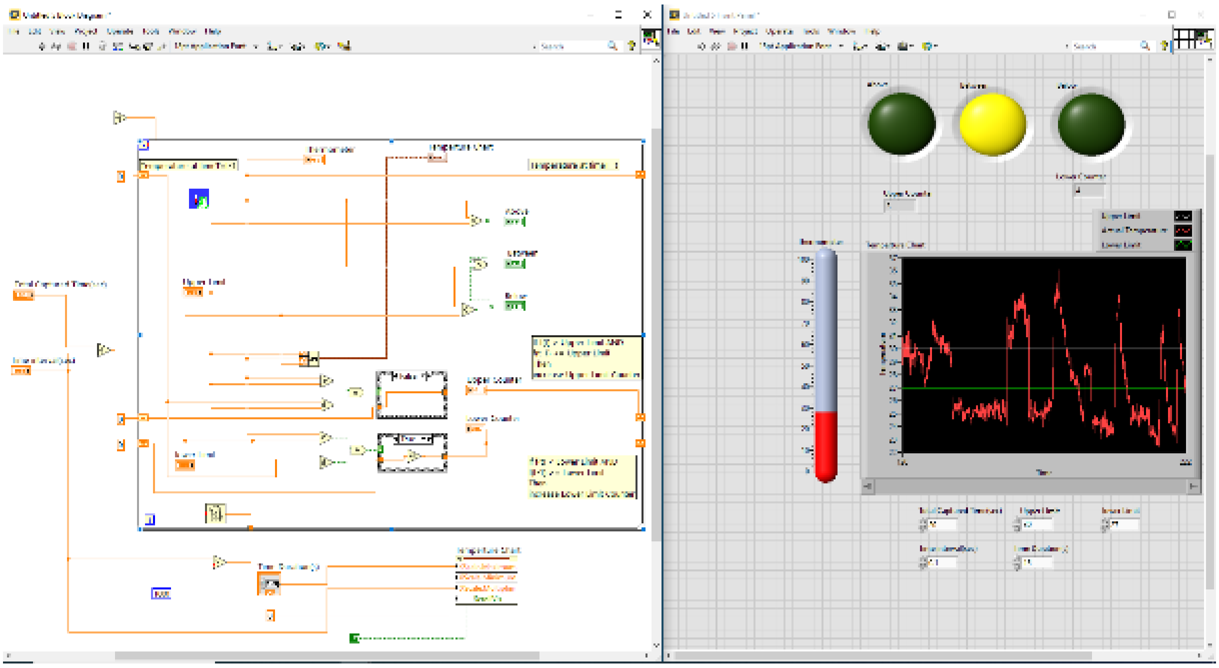


Figure 8 Exercise 9e

Other than investigating the usage of Comparison function, all the above steps can be replaced by using formula node and Mathscript node. A while loop is sued in all investigations.

Syntax of If loop in Formula Node: if condition {statement;} else {statement;}

Syntax of If loop in MAthscript Node: if (condition) statement; end

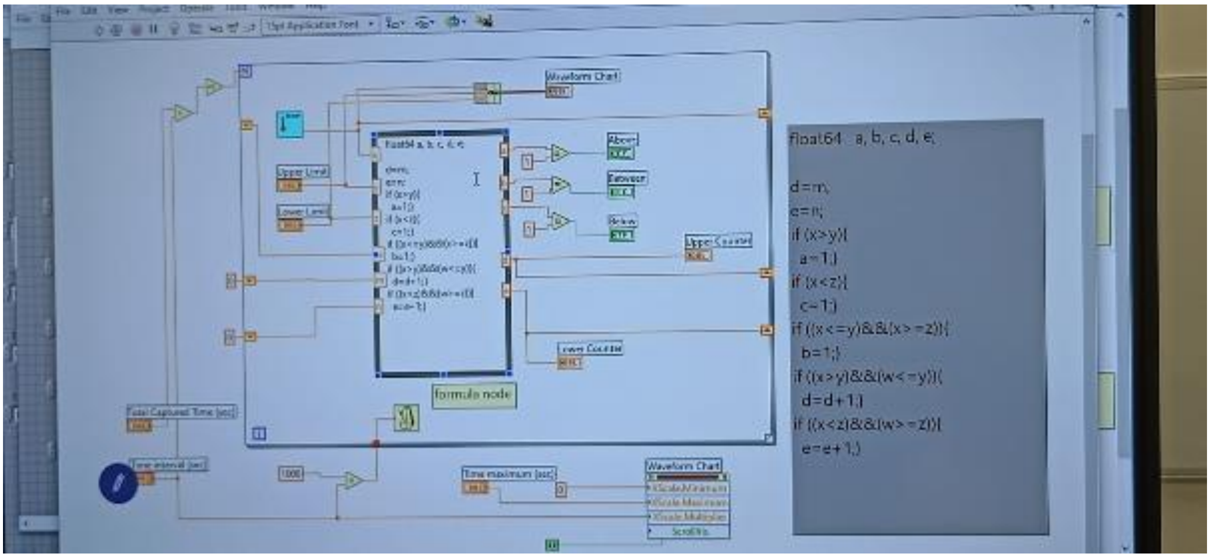


Figure 9 Syntax If loop

Comment from Assessor

Exercise 10 Temperature measurement and recording of data

To record the measured data, an Output function called "Write to Measurement File" is used. The recorded data file in this Output function can be read by Notepad or using LabVIEW's input function called "Read from Measurement File".

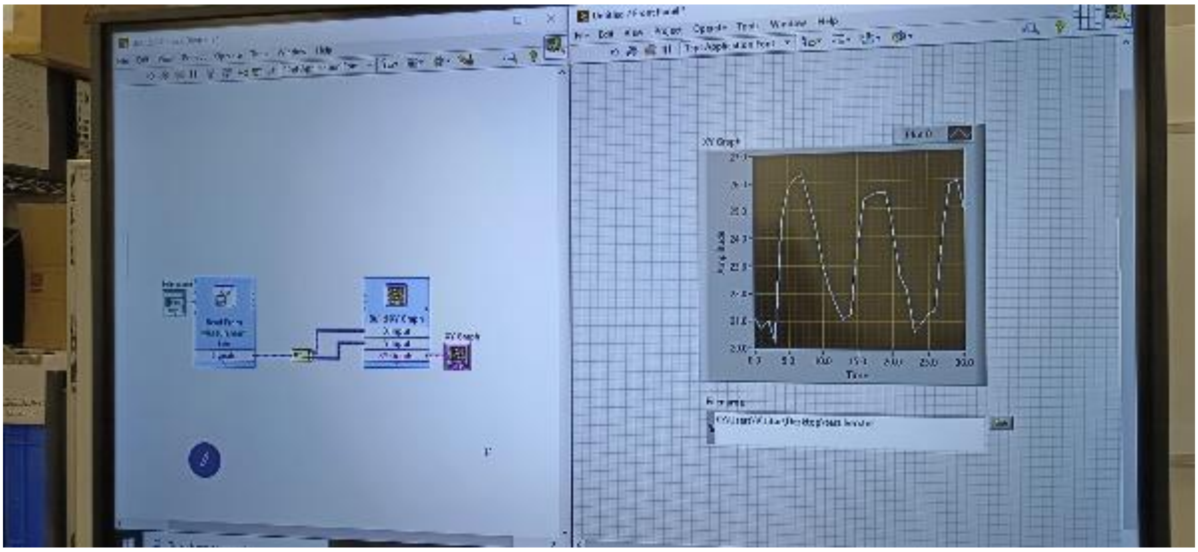


Figure 10 Read from measurement file

Comment from Assessor

Training Activity on Day 2, on 28May 2024

Exercise 11 Data analysis

The data measurements recorded in the previosu exercise can be used for performing data analysis with suitable tools to measure the Mean, Maximum, Minimum, Variance and other statistical information.

Exercsie 12 Measurement of electrical signals

In this exercise, we aim to find different values measured in a periodic function generated by BNC 2120, and using the given Frequncy Range shown on BNC 2120. The values we are measuring include Sampling Rate(Hz), No. of Samples, Peak-to Peak value and the Fundamental frequency (Hz):

	1	2	3	4
Frequency Range (on BNC2120)	0.1-10KHz	0.1-10KHz	1-100 KHz	1-100 KHz
Sampling Rate (Hz)	500K	500K	500K	500K
No. of Samples	50K	50K	50K	50K
Peak-to Peak value	4.04656	4.77694	4.7605	4.98248
Fundamental frequency(Hz)	690	10540	91380	6510

The value of Fundamental frequency can also be found by equation:

Index of max x frequency delta = Findamental frequency

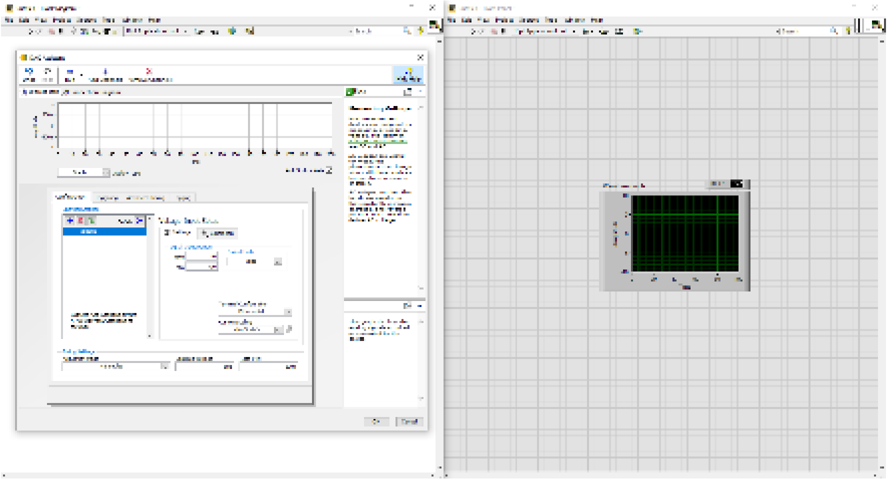


Figure 11 Exercise 12 for setting up the function to measure signals

Comment from Assessor

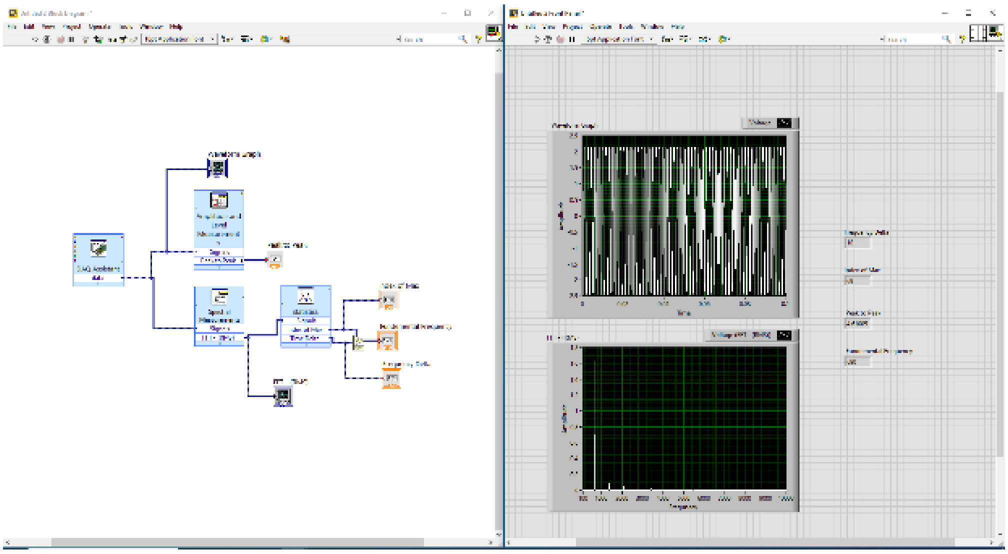


Figure 12 Ladder diagram for measurement for frequency of 0.1 – 10kHz

<u>Exercise 13</u> <u>Sending out generated signals</u>

This exercise aims to perform another feature of the data acquisition card which is to send the signals out via their Digital-to-Analog output channels, DAC0 and DAC1. Then connect the Analog output from the BNC 2120 to an oscilloscope. It is to record different values of a waveform with different frequency signals. Below are the data recorded during the investigation.

	1	2	3	4	5
Wave type	Sine	Triangle	Square	Saw-Tooth	Square
Frequency	50Hz	50Hz	50Hz	75Hz	500Hz
Amplitude	2	2	2	3	2
Noise type	Uniform white noise	Uniform white noise	Uniform white noise	Uniform white noise	Uniform white noise
Noise amplitude	0.5	0.5	0.5	0.8	0.8
Observations 1. Photo 2. Peak-to Peak value 3. Frequency	2. 5.04V 3. 92.88 Hz	2. 4.96V 3. 93.31 Hz	2. 5.12V 3. 49.98 Hz	2. 7.40V 3. 56.55 Hz	2. 5.68V 3. 499.8 Hz

Comment from Assessor

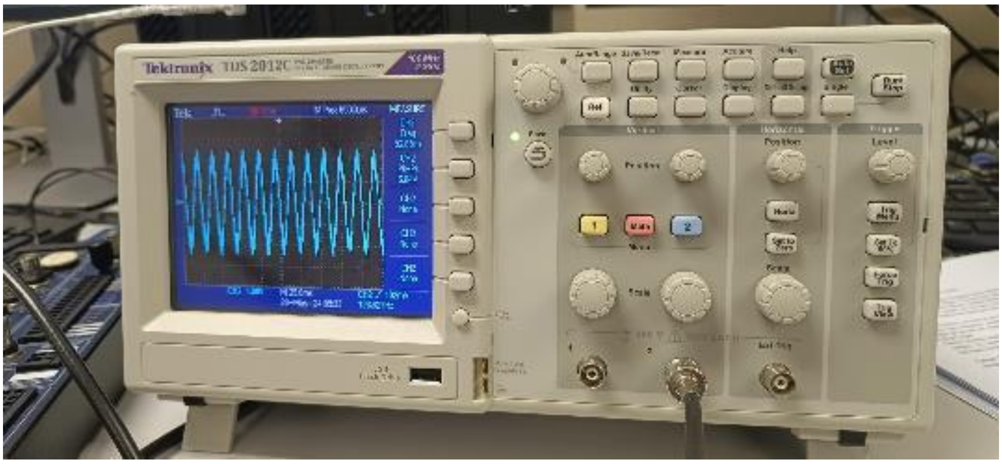


Figure 13 Triangle waveform on oscilloscope

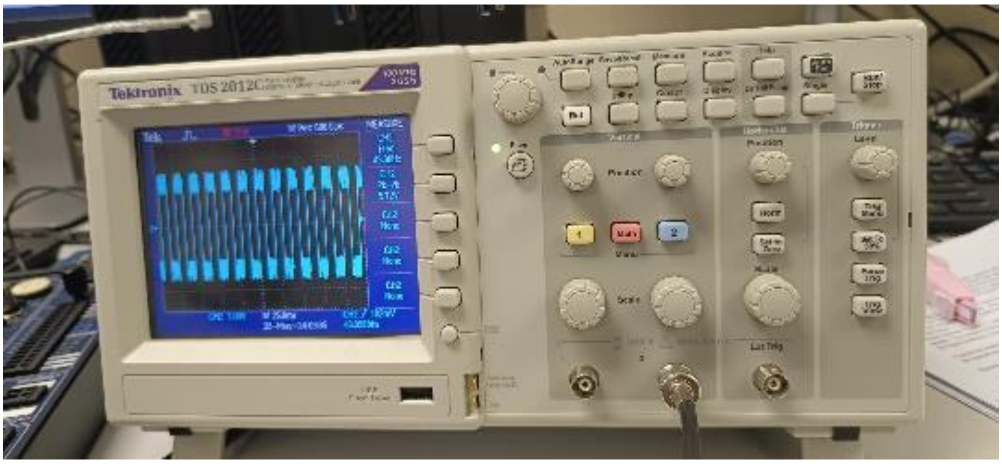


Figure 14 Square waveform

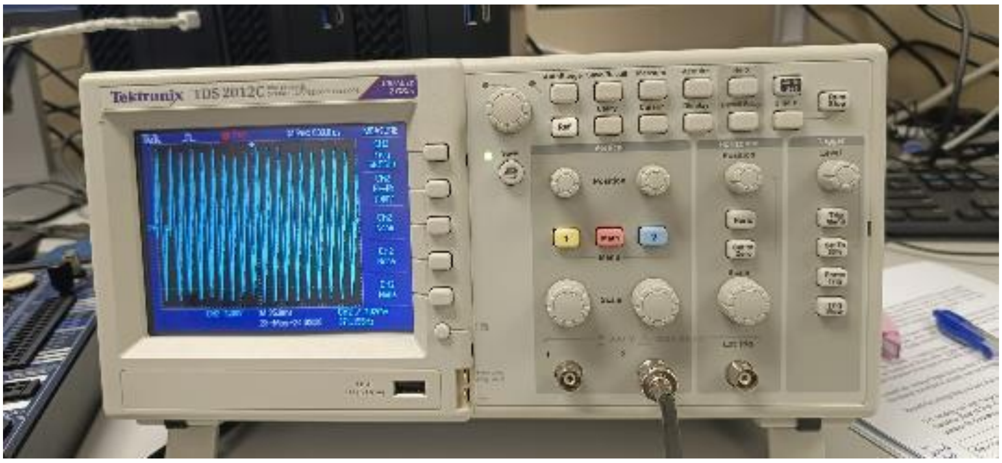


Figure 15 Saw tooth waveform

Comment from Assessor

RC Circuit – High-pass filter

A high-pass filter is later introduced in our other exercises. It can allow signals of high frequency to pass through with little attenuation while attenuating signals of low frequency.

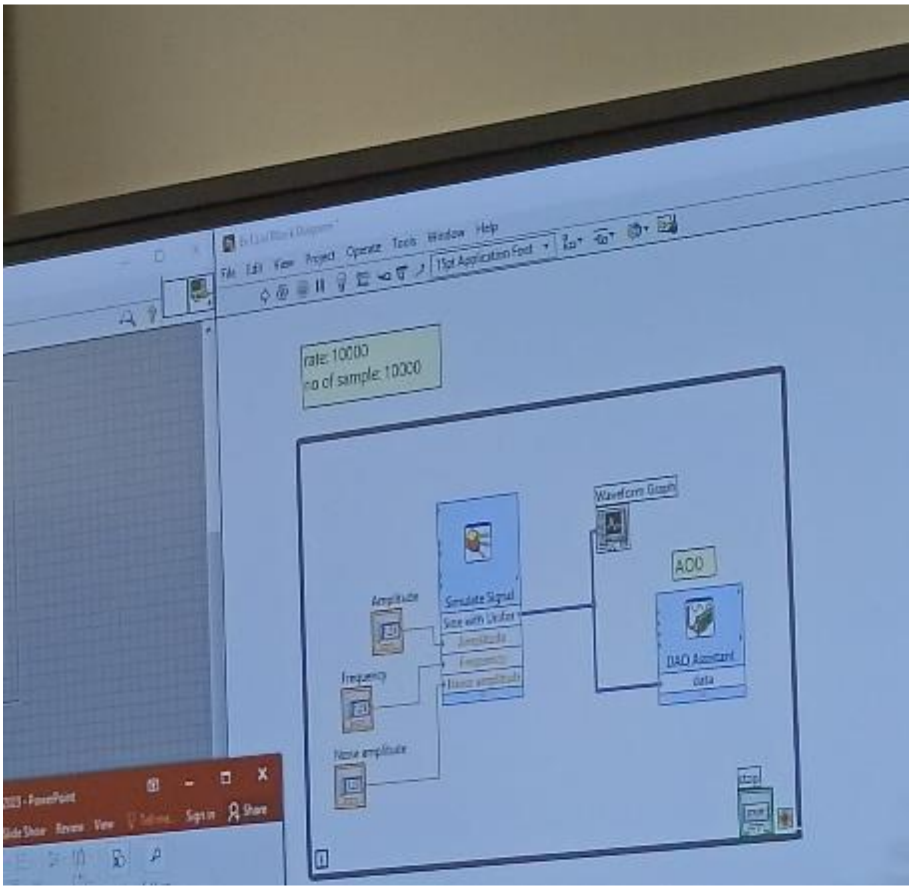


Figure 16 Ladder diagram for exercise 13

Comment from Assessor

Exercise 14

In this exercise, the system is connected with a high-pass filter. It is now used to test the input-output characteristics of circuits. Two truals for this investigation are performed. In this first trial, the resistance is set to its maximum value, and sine waves of dffierent frequency is sent out. Values of Input Amplitude (peak-to-peak), Output Amplitude(peak-to-peak) and attenuation are recorded. We have performed 8 attempts.

	1	2	3	4
Frequency(Hz)	100	300	500	1000
Input Amplitude (peak to peak)	2	2	2	2
Output Amplitude(peak-to-peak)	0.1411	0.3083	0.4323	0.6714
Attenuation	0.07055	0.1541	0.2161	0.3357
	5	6	7	8
Frequency(Hz)	1500	2000	2500	3000
Input Amplitude (peak to peak)	2	1.9021	2	2
Output Amplitude(peak-to-peak)	0.7964	0.8196	1.2858	1.6121
Attenuation	0.3982	0.4309	0.6429	0.8060

Comment from Assessor

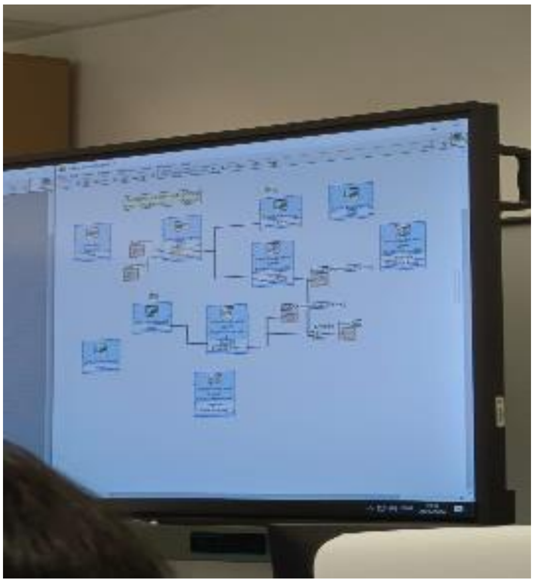


Figure 17 Exercise 14 ladder diagram

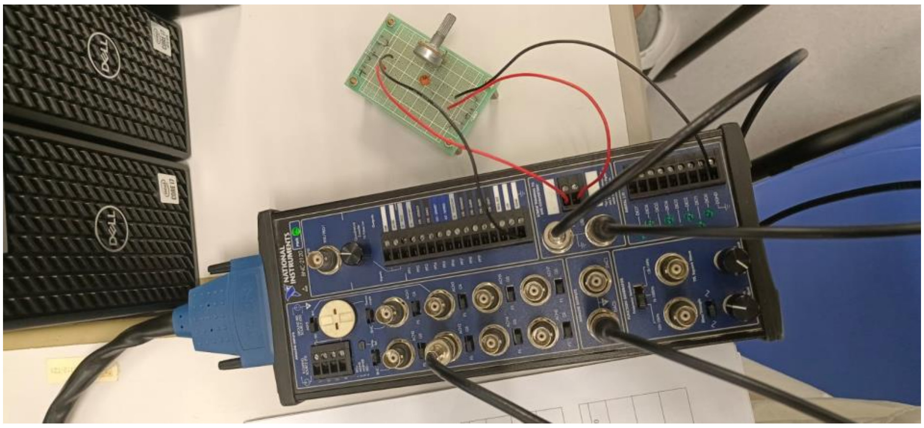


Figure 18 The data acquisition board connected with the resistor

The second triall modifies the value of R into approximately half of the full value = 0.5K(Ohm), with a cut-off frequency at 3182Hz.

	1	2	3	4
Frequency(Hz)	100	300	500	1000
Input Amplitude (peak to peak)	2	2	2	2

Comment from Assessor

Output Amplitude(peak-to-peak)	0.01417	0.04929	0.06862	0.07925
Attenuation	0.007087	0.02464	0.03431	0.03962
	5	6	7	8
Frequency(Hz)	2000	3000	3500	4000
Input Amplitude (peak to peak)	1.9021	2	2	2
Output Amplitude(peak-to-peak)	0.1079	0.1114	0.1565	0.1607
Attenuation	0.05674	0.05573	0.07828	0.08452

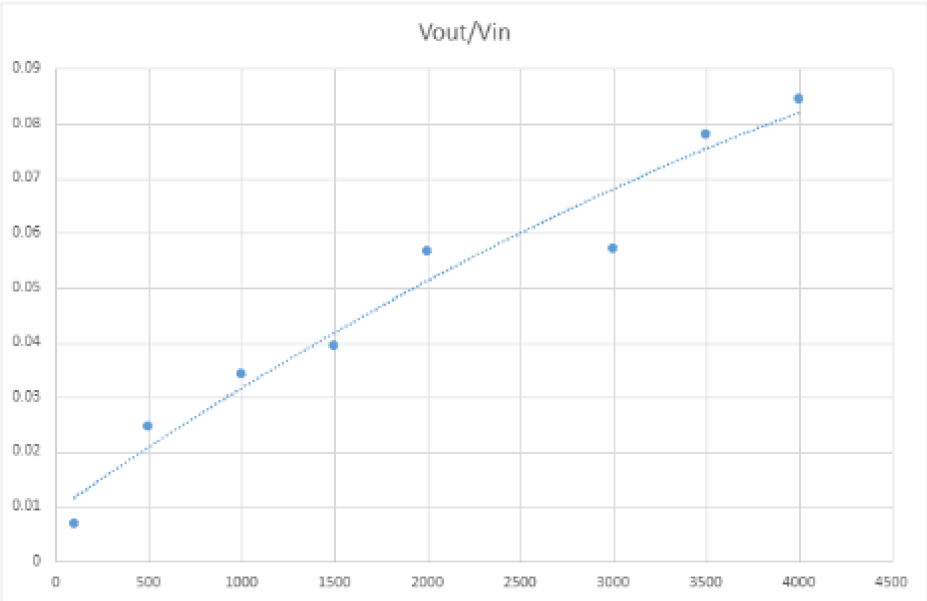


Figure 19 Graph for exercise 14, frequency to Vout/Vin

Comment from Assessor

Exercise 15 DAQmx programming

When acquiring data from the program, for a finite amount of data, if a software-btimed acquisition is used, the computer is the only device responsible for managing the acquisition. However, we cannot acquire the required data if the computer cannot give priority to the data acquisition process. Therefore, this exercise aims to use LabVIEW to tell the DAQ device about the timing of how many points to acquire and at what rate to acquire them. In such way, the problem caused by the computer when acquiring finite data can be avoided.

A thermocouple is used during the investigation for temperature measurement. Furthermore, a difference between using chart and graph is observed.

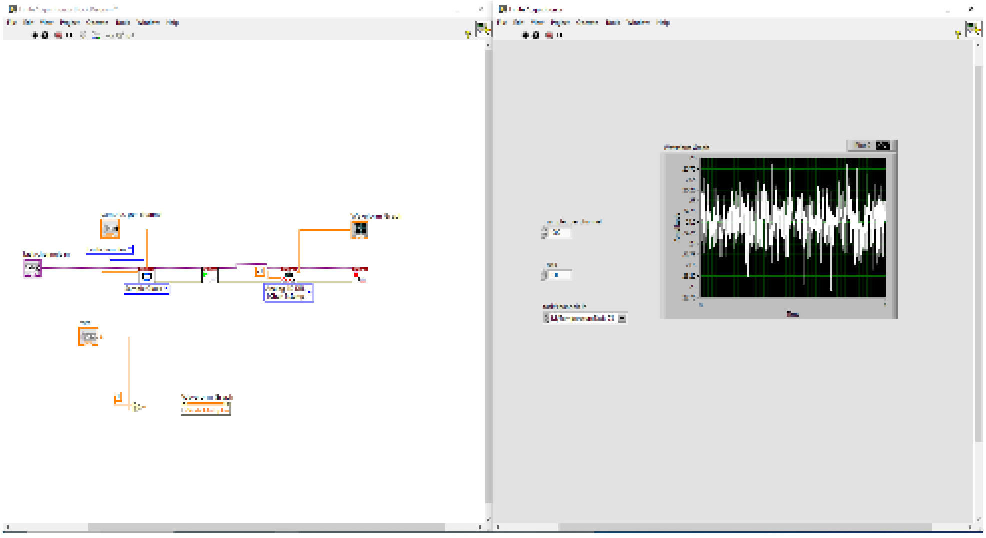


Figure 20 Exercise 15 part 1 of DAQmx programming

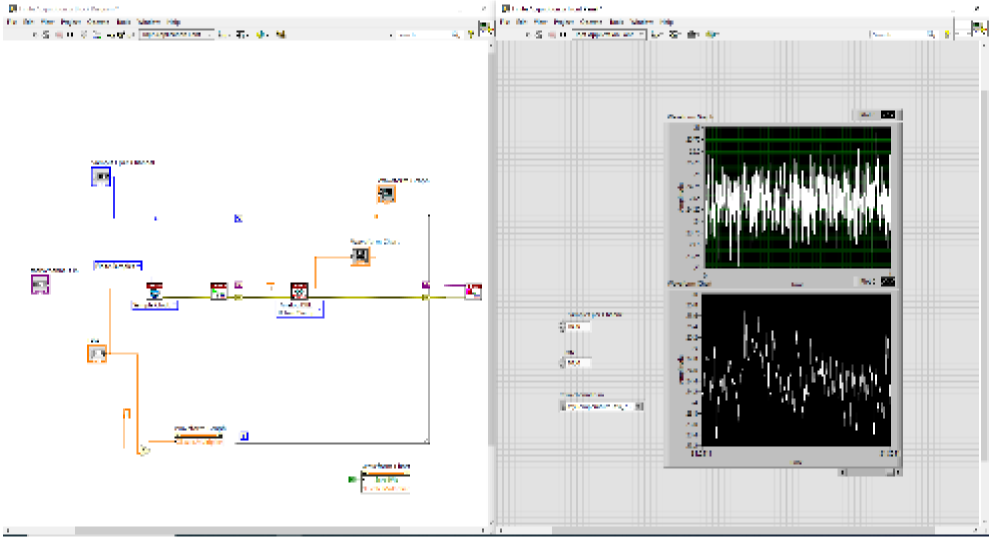


Figure 21 Exercise 25 part 2

Comment from Assessor

Training Activity on Day 3, on 29May 2024

From day 3 to day 5, we aim to investigate the use of Programmable Logic Controller (PLC) which is a microprocessor-based sequential controller with a number of inputs and outputs (True or False, 1 or 0). The outputs are based on the states of the inputs. First, different types of inputs are discussed, including push-buttons, limit switches, proximity switches (optical, inductive, capacitive or magnetic), pressure switches (hydraulic and pneumatic switches) and float switches that is for water tanks. PLC outputs are called coil contacts which are analogous to relay contacts. A relay has a coil which attracts a set of contacts.

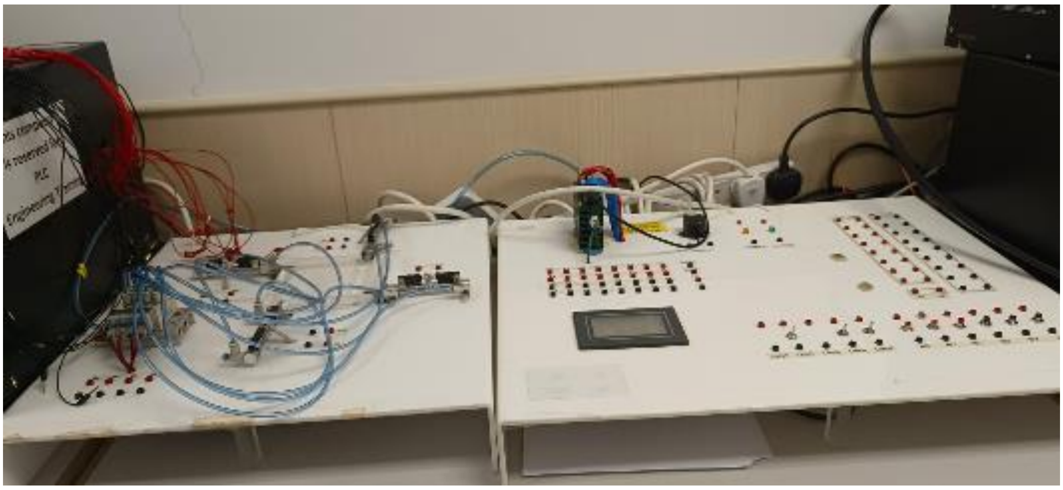


Figure 22 Control board showing PLC, switches, Pneumatic cylinders, buzzers

Figure 23 Relay

Comment from Assessor

Figure 24 Limit switch

Comment from Assessor

Figure 25 PLC Programmable Logic Control unit

We then attempted several exercises to investigate the function of digital input-output, NO and NC switches which refer to normally-open and normally-closed, Ladder diagram, self-protect, timer function and internal relays.

Exercise 1 NO and NC switches

We connect the NC and NO switches to lamps using electrical wires on a electrical board and test their operation. When the NO switch is pressed, light bulb turns on. It turns off when the switch is released. On the contrast, when the NC switch is pressed, light bulb turns off. It turns on when the switch is released.

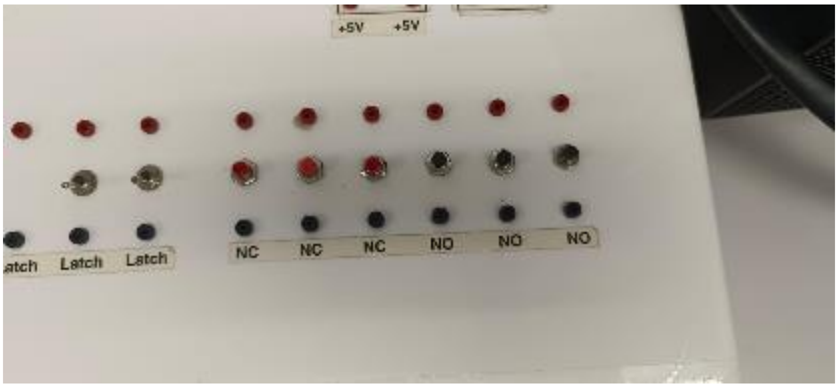


Figure 26 NO and NC switches

Comment from Assessor

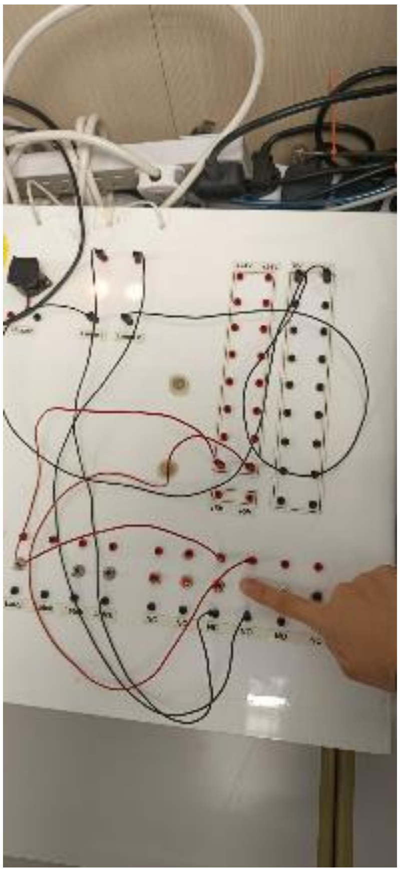


Figure 27 Green light bulbs are turned on when the NO switch is pressed. Only red light bulb is on when the NO switch is released.

Exercise 2 PLC input and output wiring connections

To set up an input-output relationship, we use a graphical programming tool called ladder diagram for program writing. We first investigate the input and output circuit of a PLC, then construct an input circuit and output circuit on the electrical board. Then, we construct a ladder diagram and test the operation of the circuit.

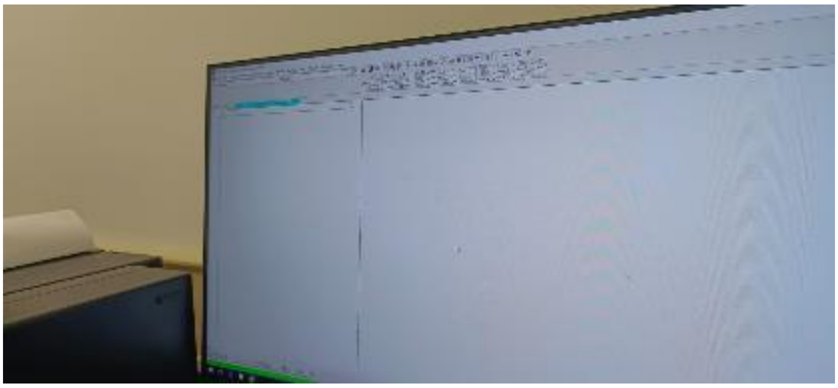


Figure 28 Ladder diagram for PLC input and output wiring connections testing

Comment from Assessor

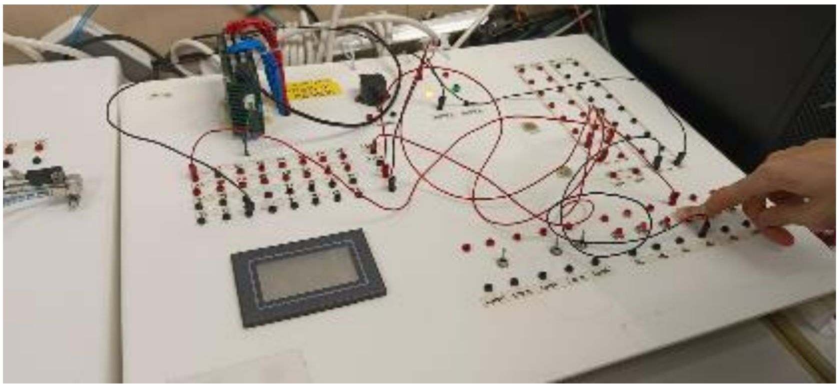


Figure 29 Testing

Exercise 3 NC switch

In this exercise we investigate the relationship between a NC switch and NO switch by writing ladder diagram and testing the operation. A table for hardware button and software symbol I/P of NC switch and NO switch is drawn and compared. The function of hardware NO switch is the same as the function of software symbol NC switch, and the function of hardware NC switch is the same as the function of software symbol NO switch.

Exercise 4 Self-protect of output (NC switch)

In this exercise, the function of self-protect is investigate by modifying the system on the ladder diagram tool such that the lamp stays on after the NC switch is released.

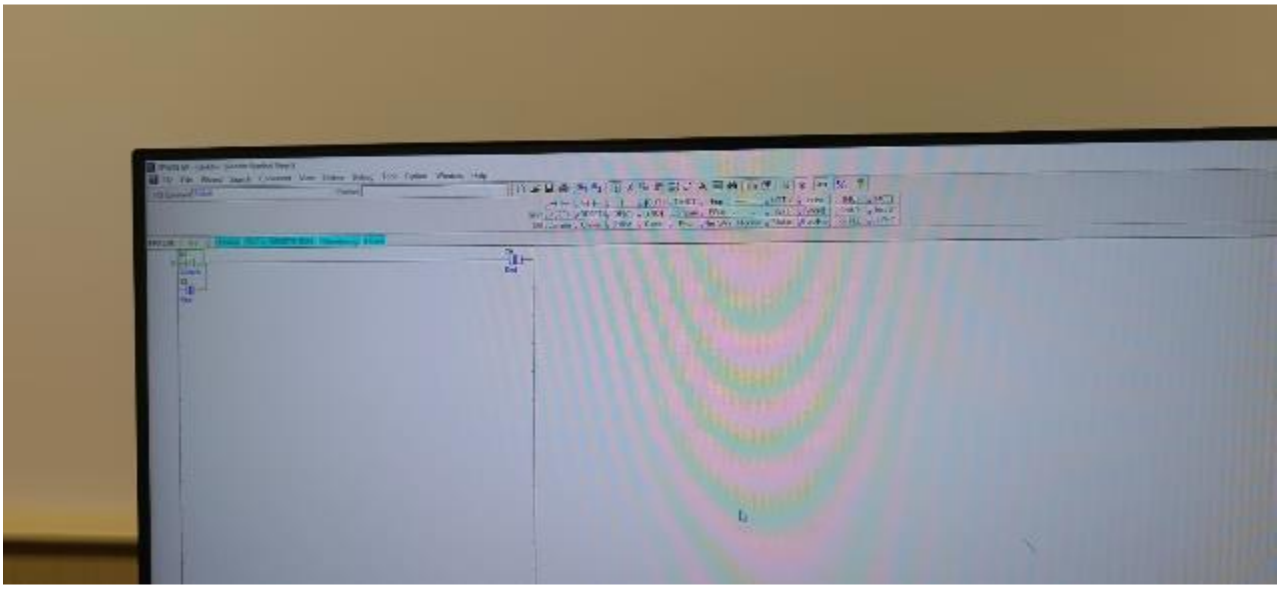


Figure 30 Ladder diagram

Comment from Assessor

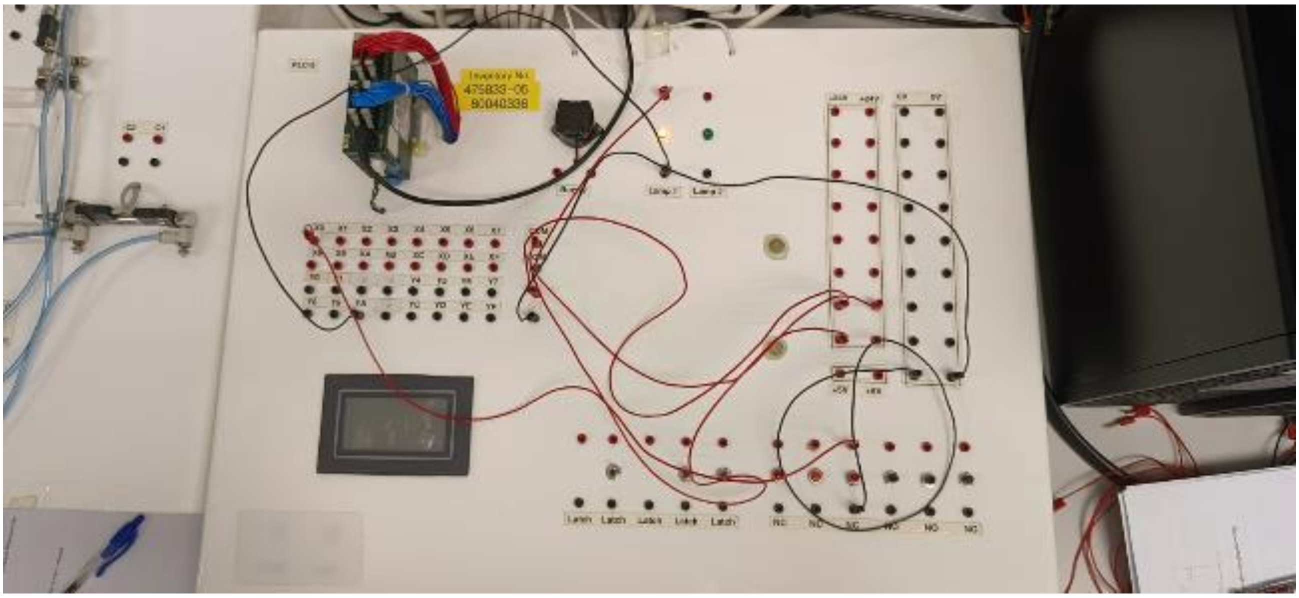


Figure 31 The light bulb remains on when connected to a NC switc

Exercise 5 Self-protect of output (NO switch)

This time the function of self-protect has to be activated using a NO switch. The lamp has to be sure to stays on after the NO switch is released.

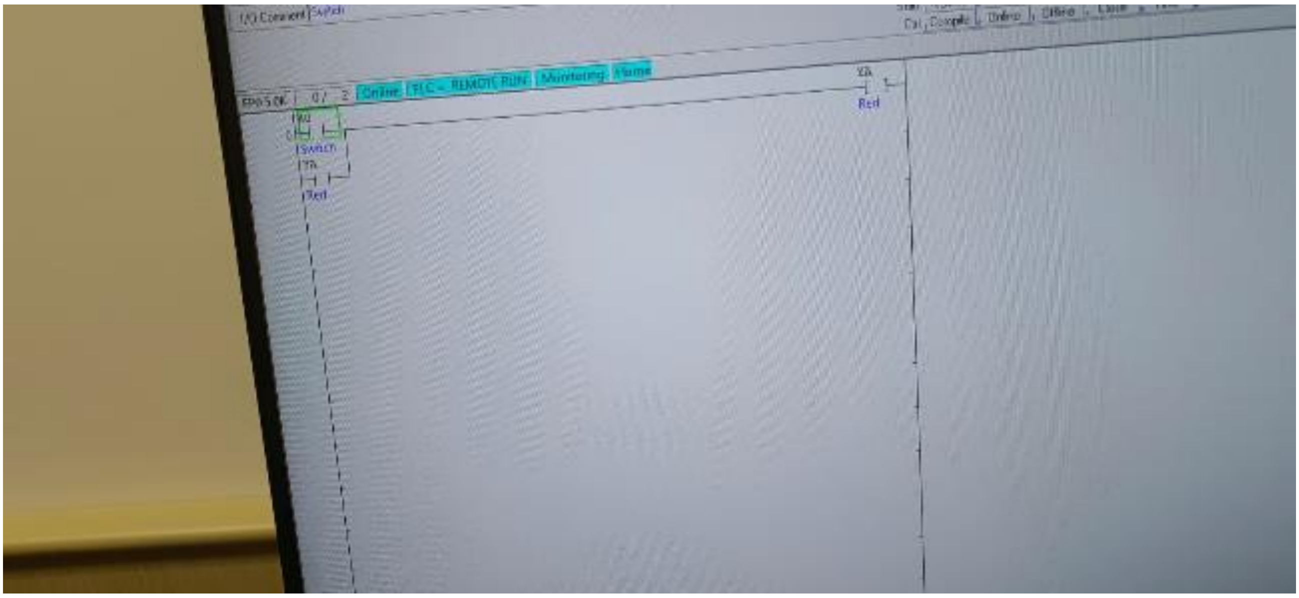


Figure 32 Ladder Diagram of NO switch testing

Comment from Assessor

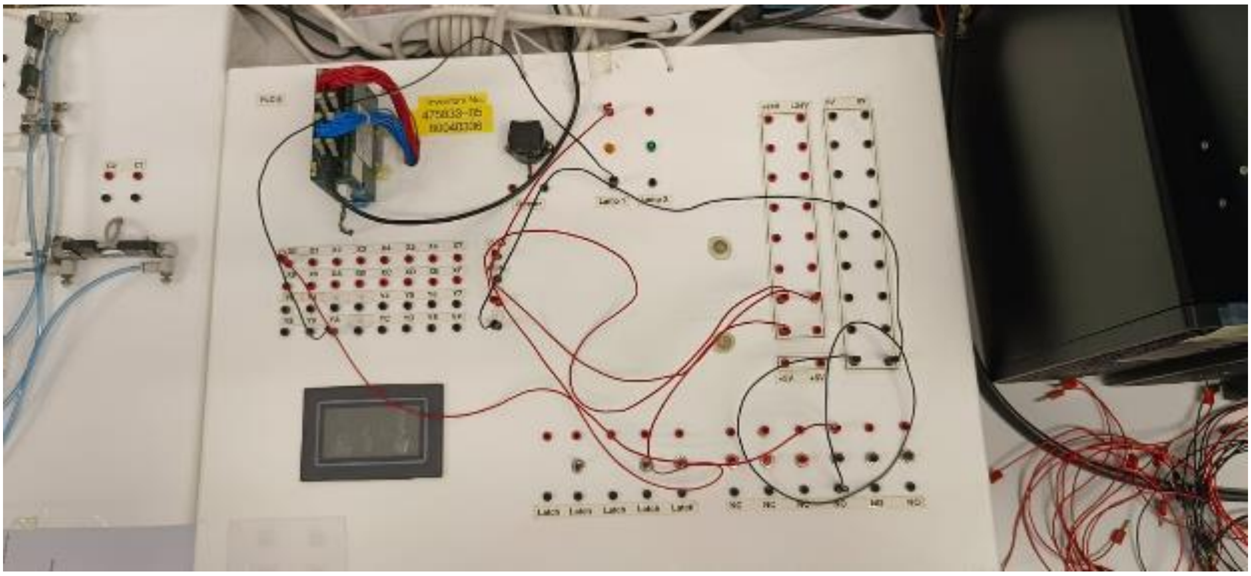


Figure 33 The light bulb is off when the NO switch is released

Exercise 6 Switching off self-protected output using a NO switch

This exercise aims to use two NO switches, one wired to input X0 and another one wired to input X1 for turning on and turning off the lamp respectively.

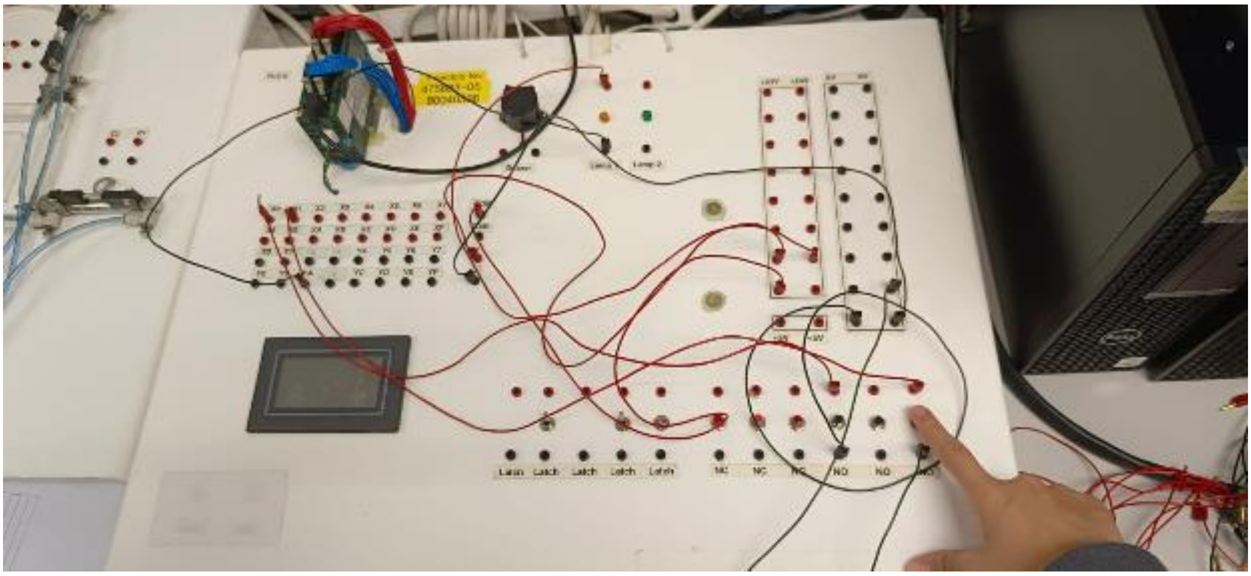


Figure 34 Switching off self-protected output using a NO switch

Comment from Assessor

Exercise 7 Switching off self-protected output using a NC switch

Now this exercise modifies the program in exercise 6 by replacing one NO switch to a NC switch for cutting off the lamp. So in this program, one NC switch and one NO switch will be used.

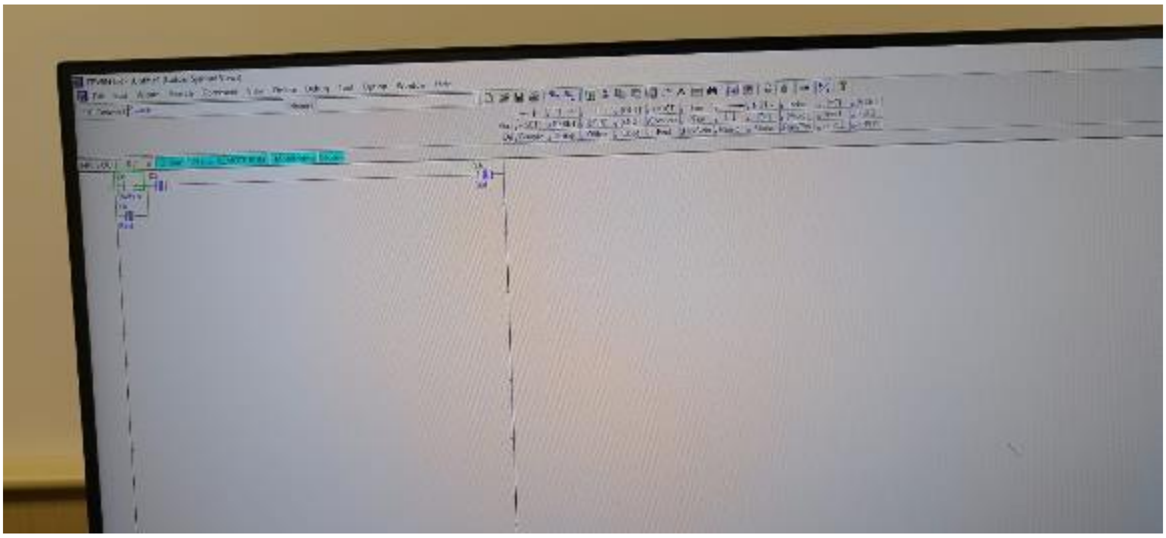


Figure 35 Ladder diagram for exercise 7

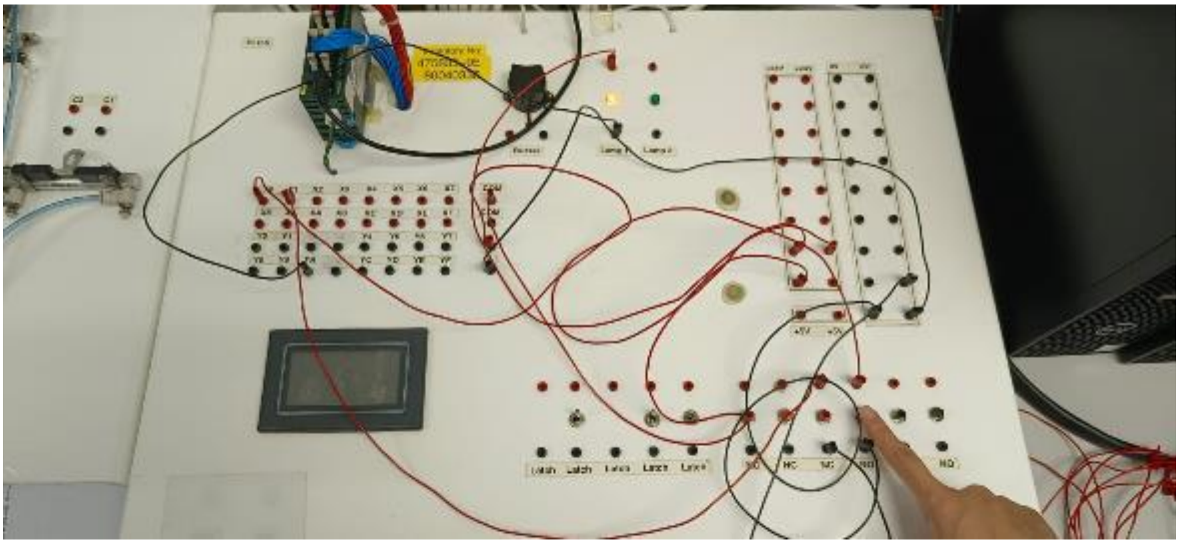


Figure 36 When NO switch is pressed, light is on

Comment from Assessor

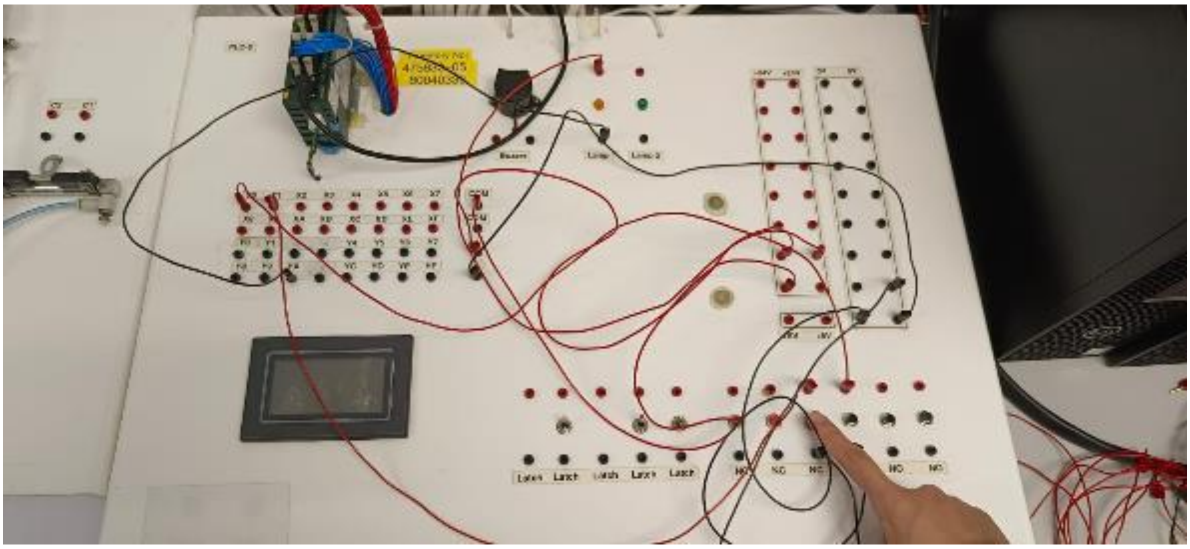


Figure 37 When the NC switch is pressed, the light bulb is off

Exercise 8 Timer function

This exercise aims to make use of a time function in the ladder diagram such that after a red lamp is switched on by pressing a NO switch, it stays on for 3 seconds and then turns off.

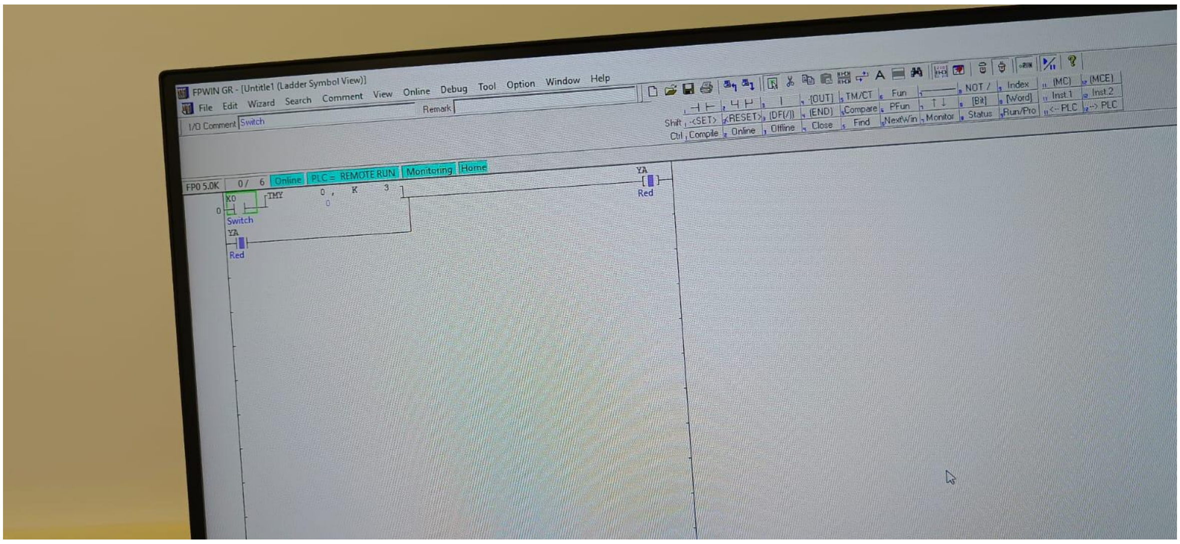


Figure 38 Ladder diagram for exercise 8

Comment from Assessor

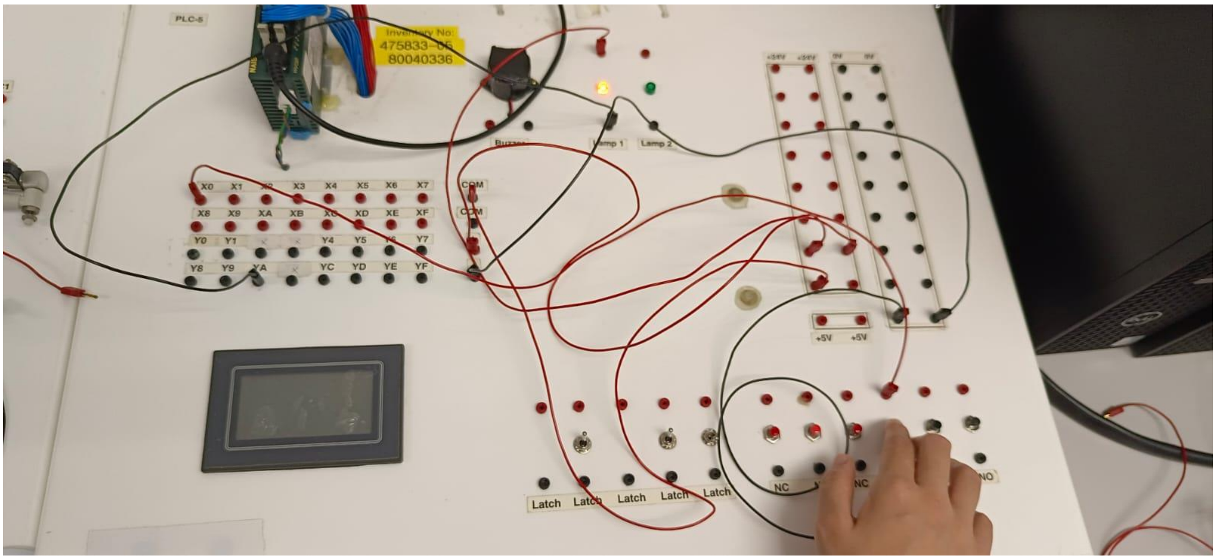


Figure 39 Testing for exercise 8

Exercise 9 Internal relays

In this first part of this exercise, we are to investigate the use of internal relays. We set up a ladder diagram using a NO switch, two timer functions and several inputs and outputs in the system, so that after pressing a NO switch, the red lamp goes on for 2 seconds and then goes off, and the green lamp goes on immediately for 3 seconds and then turns of

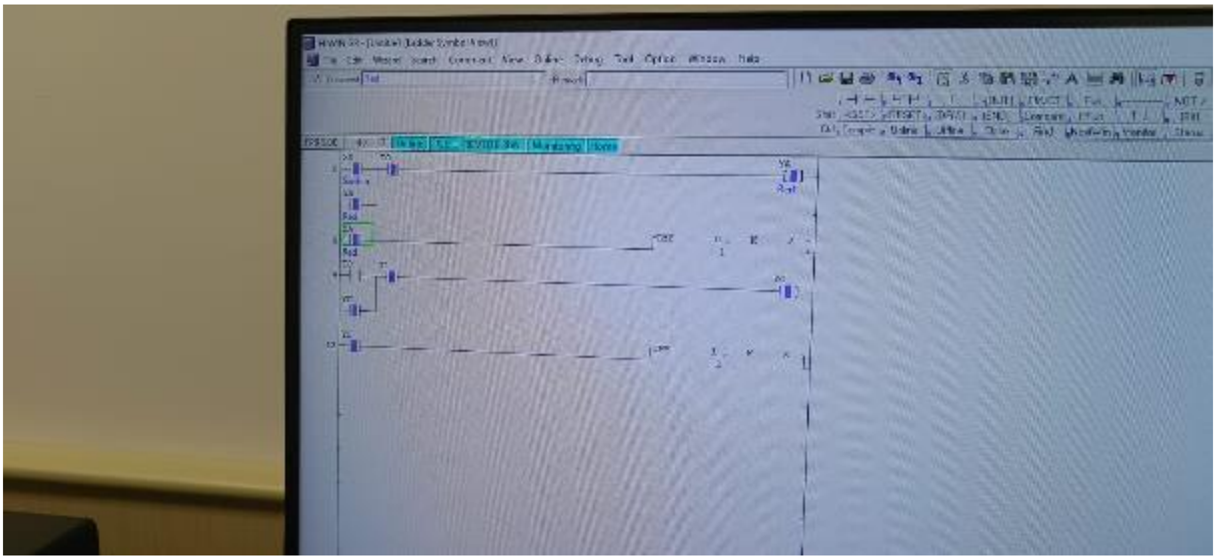


Figure 40 Ladder diagram for exercise 9a

Comment from Assessor

Training Activity on Day 4, on 30May 2024

Exercise 9 Internal relays

In the second part of this exercise, the system is modified to a new sequence, where red lamp turns on for 3 seconds then goes off, followed by green lamp turns on for 2 secnods and then goes off and red lamp goes on for 2 seconds and goes off. In this exercise, the cascade method is practiced with the use of 4 internal relays.

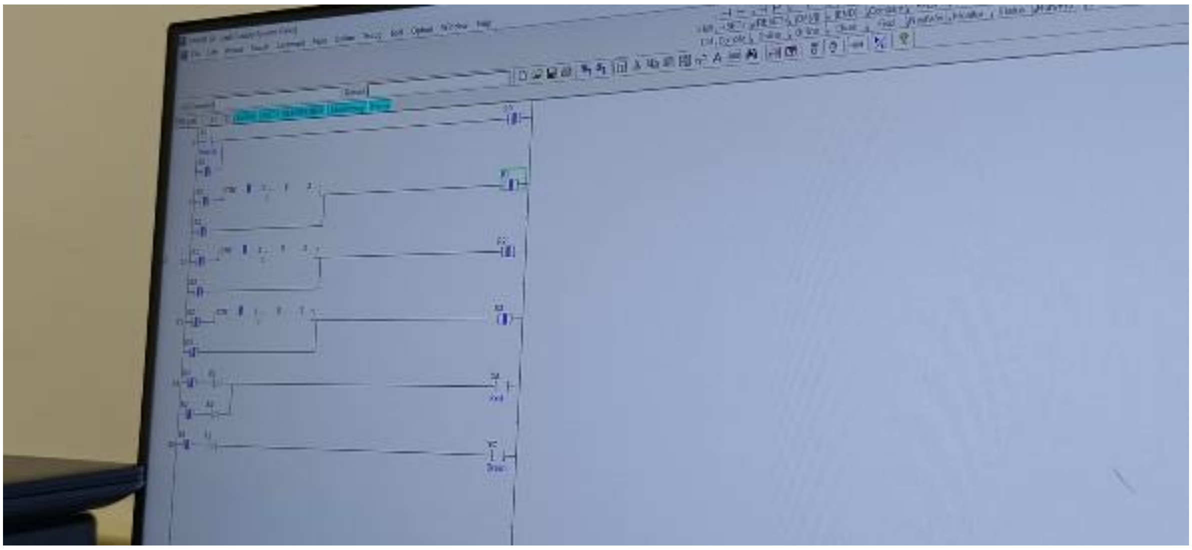


Figure 41 Exercise 9b

Exercise 10 Repeated cycles

In this exercise we attempt to set up a program such that the system can repeat itself after the NO switch is pressed. The sequence of the repeated cycles involves two tasks, the first is to make internal relays return to 0, and the second task is to make the first internal relay to go to 1 to re-start the sequence. A total of four internal relays are used, where R0 is to start the system, R1, R2 and R3 is to run the system. R3 NC switch symbol is inserted on each line of the ladder diagram so it can be used to cut the self-protect R0, R1 and R2 when it goes false after being pressed. R4 stores the data of R3 and is to reset and switch on R0 and cut R3.

Comment from Assessor

Figure 42 Exercise 10

Exercise 11 Stop switch for repeated cycle

In addition to the system set up in exercise 10, every step on the ladder diagram is added by a NC switch, named X1 to stop the repeated cycle.

Comment from Assessor

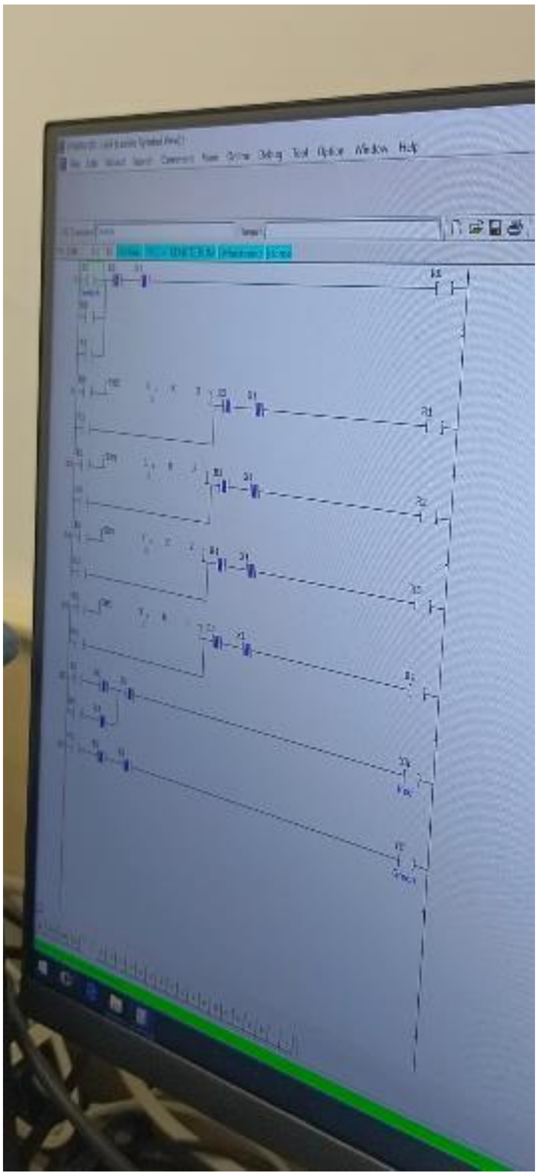


Figure 43 Exercise 11

Exercise 12 Fixed number of cycles (use of Counter function)

In this exercise, we modified the pervious program such that after the system repeats the red-green-red sequence for five times, it stops. We used a counter in each line to count the number of cycles. A counter has two inputs, one for actuating the counts and one for resetting the counter.

Comment from Assessor

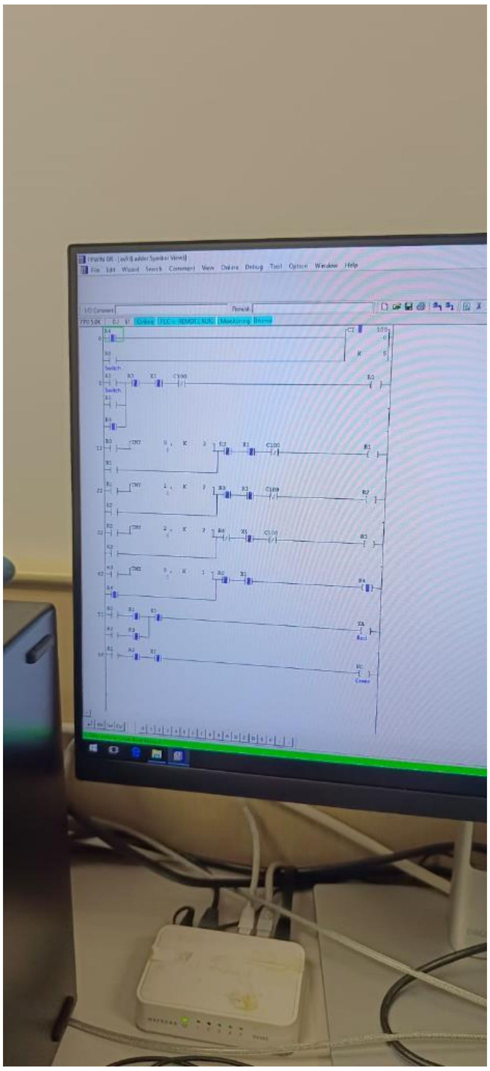


Figure 44 Exercise 12

Pneumatic actuators: cylinders and valves

Starting from exercise 13, we investigate the operations in many industrial processes that are carried out by pneumatic cylinders. In this cylinder, the flow of compressed air into the front or rear portion of a cylinder is controlled by a valve. A sectioned valve will be shown to you. The movement of the spool is controlled by a solenoid. Some valves have return springs so that the spool returns to its original (de-energized) state when the current to the solenoid is removed. Other valves have solenoids on both ends.

Comment from Assessor

Below is the operation of a 5/2 valve, which 5 stands for 5 holes, 2 means two positions.

*figure of the 5/2 valve

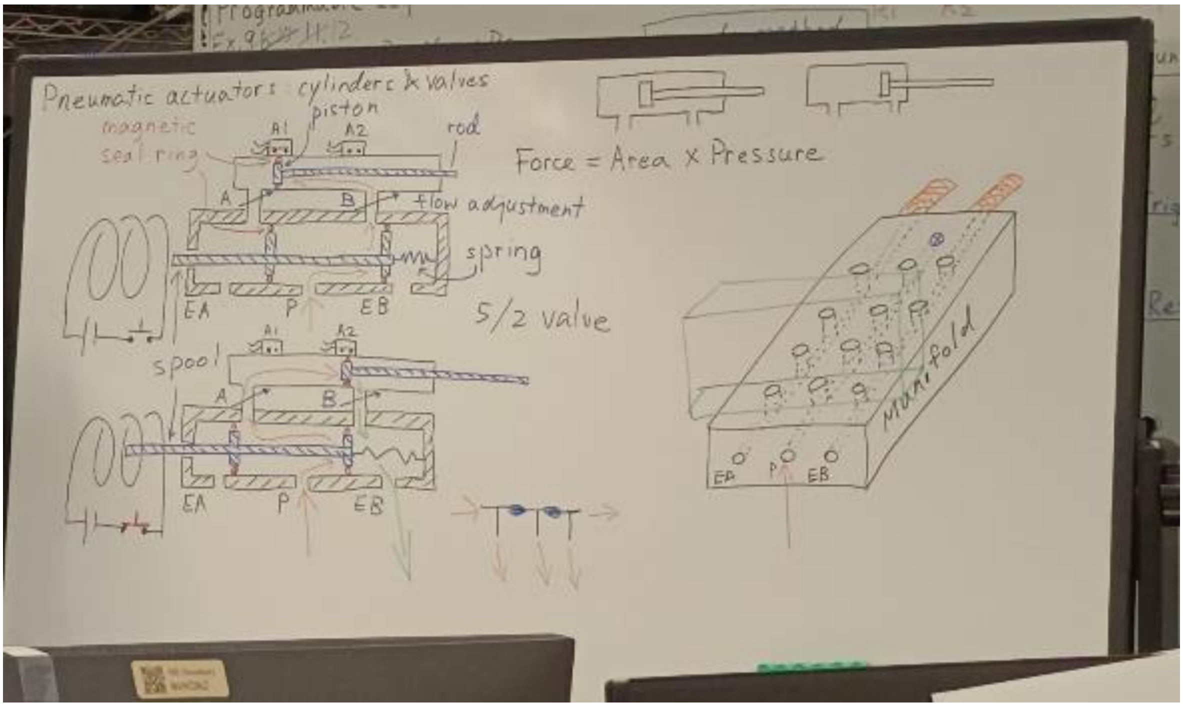


Figure 45 Pneumatic cylinders and valves

Exercise 13 Operation of valves and cylinders by push buttons

In this exercise, we used two NO switches and two NC switches to connect to each of the four valves. The table shows the type of push button connected to the corresponding valve and the movement of cylinder.

Valve	Type of push button (NO or NC)	Movement of cylinder (extend or retract)
A+	NO	Retract
B+	NC	Extend
C+	NC	Extend
D+	NO	Retract

Exercise 14 Sequential extension of cylinders

In this exercise, we aim to set up a system to make each cylinder extends fully sequentially and all retract at the same time. The equipment on the cylinder include two magnetic sensors, one is for detecting the extended position of the cylinder rod (A+, B+, C+, D+) and another one is for detecting the retracted position (A-, B-, C-, D-); and the magnetic ring on the piston which works with these two sensors to give

Comment from Assessor

signals to the PLC. A2, b2, c2 and d2 are sensors mounted on cylinders A, B,C,D to detect heir full extension.

The sequence of the system can be represented as: A+, B+, C+, D+, A-B-C-D-

Step	Input	Output	Operation
1	Push button (X0)	Y4	A+
2	a2 (X1)	Y5	B+
3	b2 (XZ)	Y6	C+
4	c2 (X3)	Y7	D+
5	d2 (X4)	(Y4)’ (Y5)’ (Y6)’ (Y7)’	A-B-C-D-

However, in the first approach of this exercise, the cylinder bounds a little bit when retracting as the diagram gives a signal that it resets before finishing the cycle. Also, the magnetic ring was too loose on the cylinder. After modifying the diagram, the problem is fixed, and the cylinder can extend and retract smoothly.

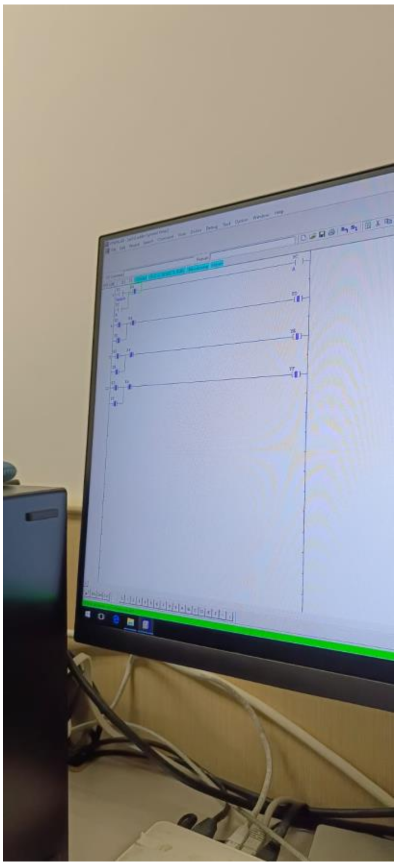


Figure 46 Exercise 14

Comment from Assessor

Exercise 15 Improvement on the sequential extension of cylinders

In addition to the system set up in exercise 14, in this exercise we aim to make sure each cylinder is in its retracted position before it is asked to extend. More inputs and outputs are needed to finish this step.

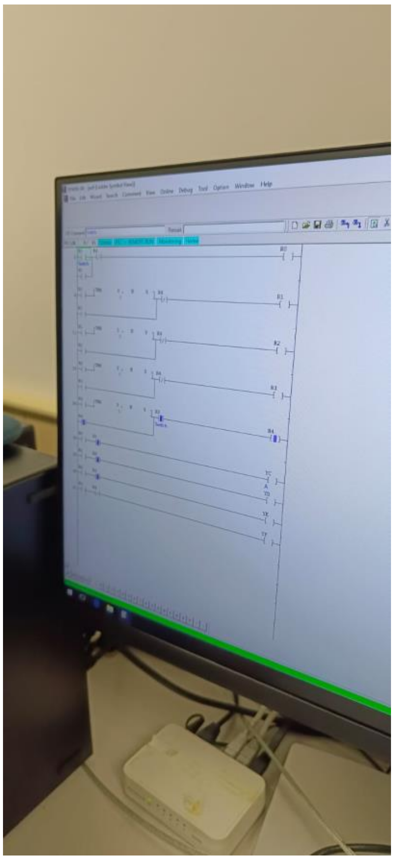


Figure 47 Exercise 15

Exercise 16 Moving cylinder block round the track

Now, we aim to modify the program of PLC again such that after placing a brass cylinder block in front of cylinder A, the switch is pressed, and the cylinder push the block out and wait for 0.5 second for the second cylinder to push the block again until the cycle ends. The magnetic ring on the cylinder is adjusted so that the flow rate is in a suitable pushing speed and avoid the block bounding back.

The sequency of the system is: A+, A-B+, B-C+, C-D+, D-

Comment from Assessor

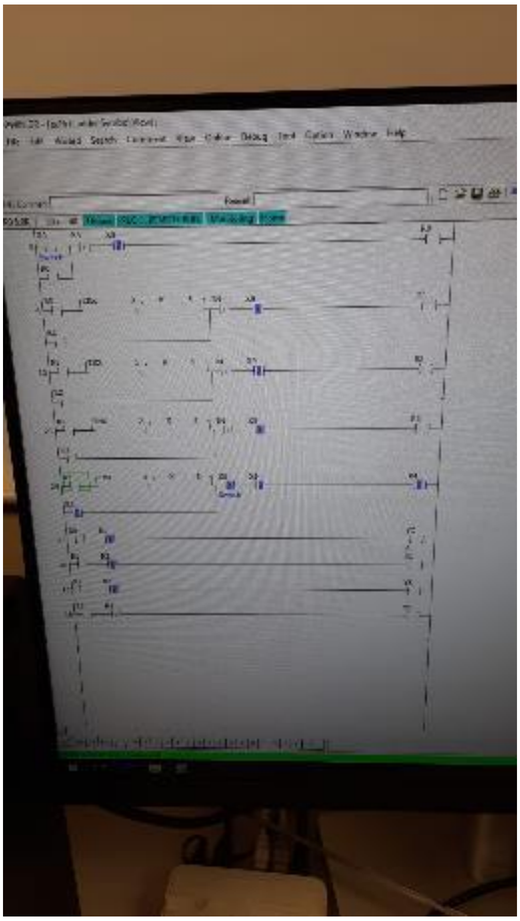


Figure 48 Exercise 16

Exercise 17 Two-button starting of sequence

In previous exercises, we only need to press on switch to start the system. However, if the operator is not careful and places one of his hands in the track while using his other hand to press the start button, his fingers on the hand that is inside the track might get injured. Therefore, in this exercise, we investigate safety measurements for operators. The sequence can only start with two push buttons being pressed two hands within 0.5 second of each other, which is physically about a metre apart.

Comment from Assessor

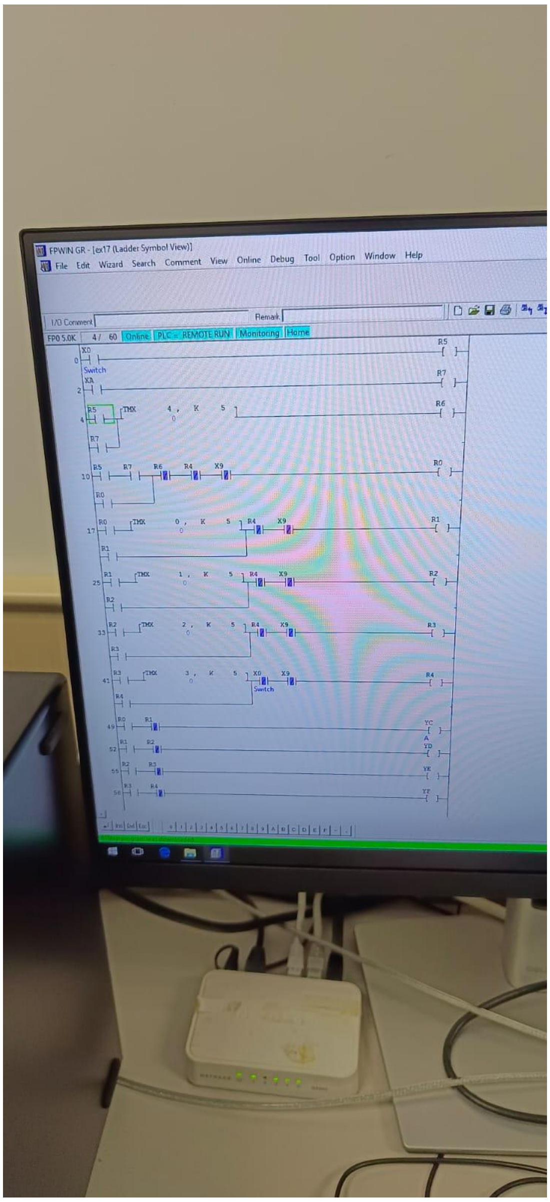


Figure 49 Exercise 17

Comment from Assessor

Training Activity on Day 5, on 31May 2024

On day 5, the last exercise, no. 18 is attempted.

Exercise 18 Emergency Stop (all cylinders hold at present position, Re-set button to retract)

In this exercise, we modified the ladder diagram used in exercise 17 by adding an additional stop and reset button which can stop the cylinder and make it remain at whatever positions they are at. The system is then reset, and every cylinder retracts.

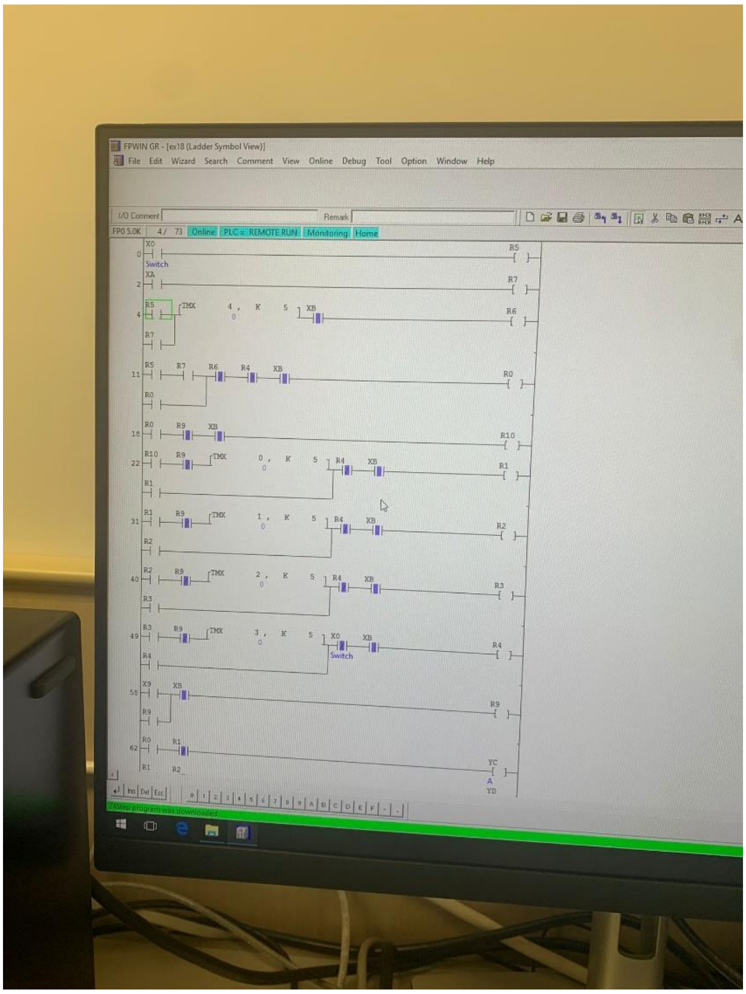


Figure 50 Exercise 18 Emergency stop

Comment from Assessor

Summary for Automation and Instrumentation Practice

The Automation and Instrumentation module gives me a detailed understanding on I/O control through drawing ladder diagram and analyse the logic gate of the program. I have gained more ideas about automation and instrumentation through hands-on experience through learning data acquisition, post-processing, and Programmable Logic Circuits using LabView and FPWIN GR device developed by Panasonic.

I found writing Ladder Diagram and learning to use Programmable Logic Controller really useful, and it inspired me to further loop up on the internet to learn more about their usages in different applications. For instance, after learning about I/O controls and relay, I have a clearer understanding of how a relay is used in a circuit to switch and control the circuit using a low-voltage or a low-current signal. It is also a crucial part of industrial automation and process control systems, which provides various functions in a control system. In the training session, various important usages of a relay is practiced and shown, including acting as timer to control the delay of implementing the next function and manipulate real-world objects, such as pneumatic valves with the PLC, as well as guiding the bronze cylinder with four pneumatic cylinders; multiplexing and switching controlling the NO and NC switches to perform multi-way control of the system.

For the LabVIEW session, it also provides me with tremendous knowledge on real-time data acquisition and manipulation. I learnt how to collect data from experiments and process them according to the tasks. I have also learned to simulate signals and manipulate with various functions, measuring temperature using BNC 2120 and data acquisition board, warning lights setup, exporting signals to the data acquisition board so it can be shown as waveforms on a physical oscilloscope for us to read.

Overall, I believe the training session inspires me on constructing solutions for tackling challenges related to control systems design in the future, I look forward to applying them in my future career.

Comment from Assessor

Comment from Assessor

Training Module: Workbench Practice

Training Module:	Workbench Practice WP		Student Group Attended:	ME1
Training periods		From 03June to 07June 5 August for day 1 makeup session		

Training Activity on Day 1, on 03June 2024

The training took place in VTC in Kowloon bay, room 521 and 515 and supervised by instructor Mr. Sam Wong.

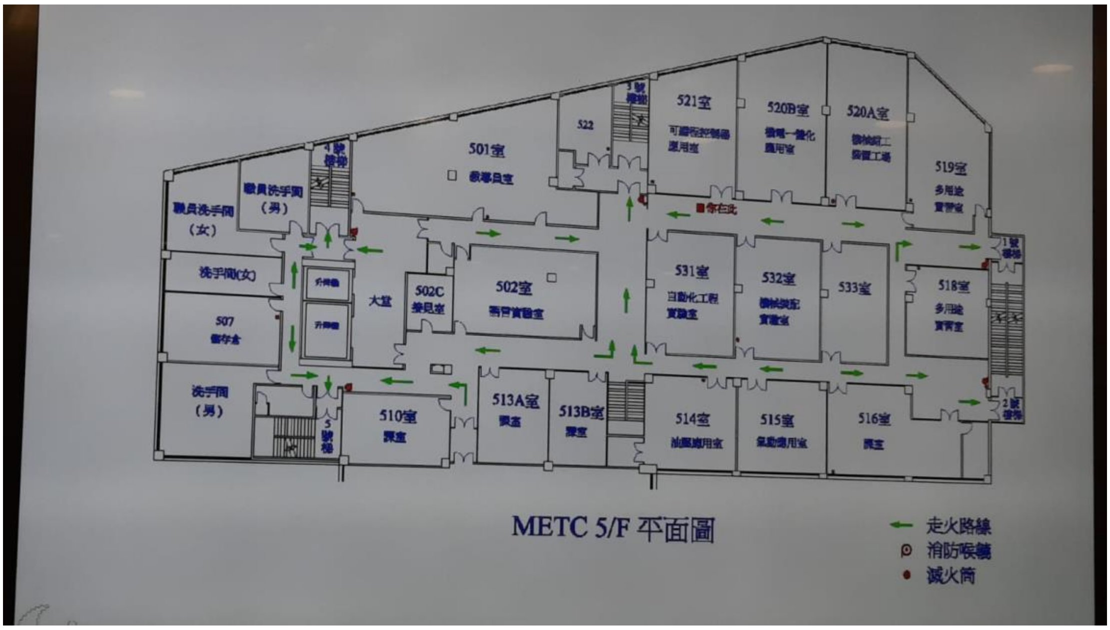


Figure 51 5/F Floor plan

Comment from Assessor

Figure 52 Training room for hydraulic practice

Figure 53 Inside of the training room

On the first two days of the practice, we learnt about Hydraulic (Basic & Electro-hydraulic system) and we aim to get familiar with the circuit setup and apply the hydraulic knowledge in maintenance of the mechanical systems. The first exercise is about Hydraulics and pressure measurement. In this exercise, the accuracy of the piston is 2 bar.

Comment from Assessor

We set up the hydraulic system following the instruction diagram on the worksheet. The hydraulic cylinder is connected with jumpers from the piston retract side to the Shut off valve (SOV) which is close position and is further connected to the oil tank. The piston extension side of the pressure gauge is connected from the hydraulic cylinder to the electric motor and the pressure relief device to the oil tank. There is also a spring on the right side of the device to control the pressure flowing through the tube by directing the oils to a certain position (it is shown as an arrow in graph.) The exercise is done by adjusting the supply pressure from 10 bar to 50 bar and recording the pressure reading shown on the pressure measuring meter on the extension side and the retraction side.

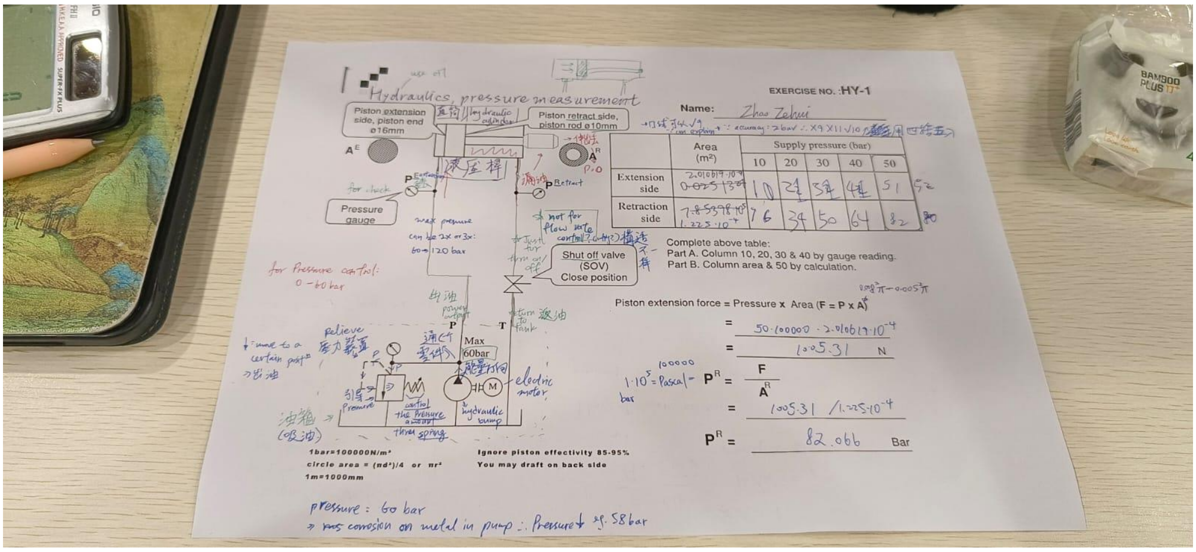


Figure 54 Worksheet for exercise 1 (1)

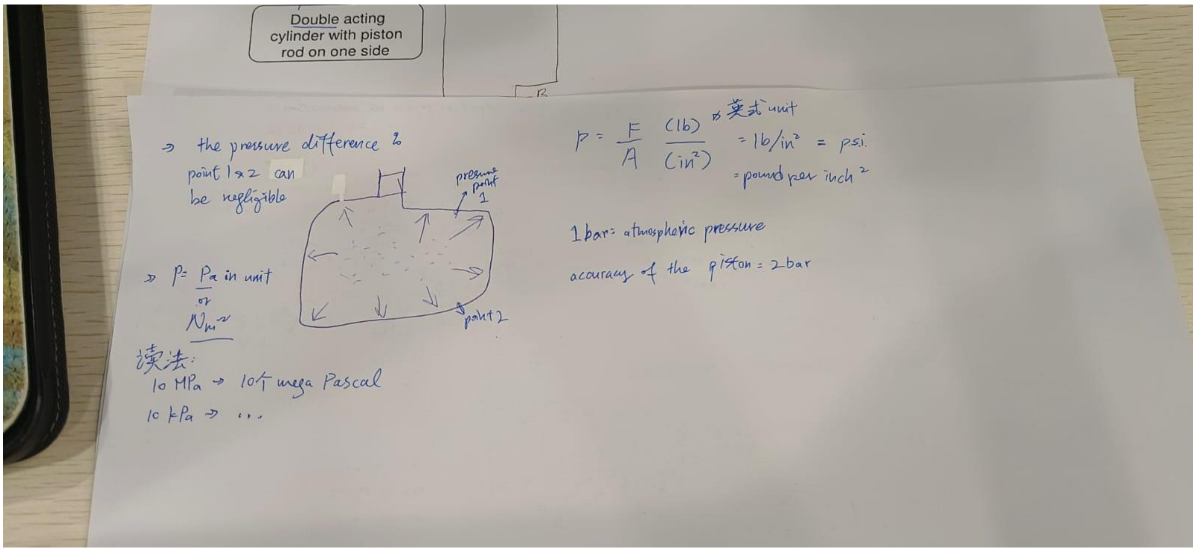


Figure 55 Worksheet for exercise 1 (2)

Comment from Assessor

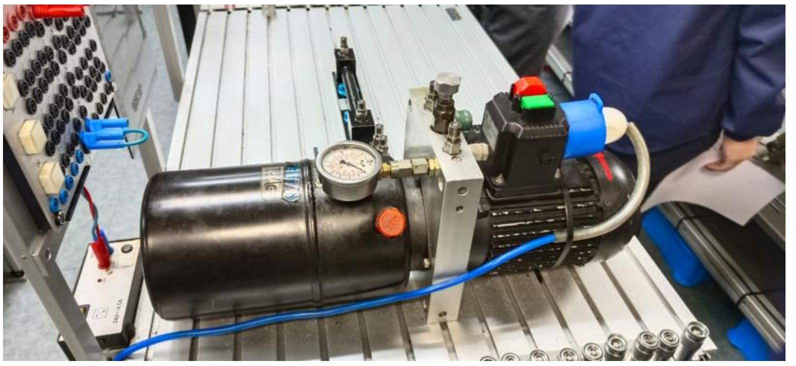


Figure 56 Electric motor and the pressure relief device and the oil tank

Figure 57 Pressure gauge

Figure 58 Shut off valve

Comment from Assessor

Figure 59 Piston

Figure 60 The whole setup

Comment from Assessor

The equation for calculating the Piston extension force is equal to Pressure x Area (F = P x A). The area for calculating the piston extension force is figured out by subtracting the area of the piston's extension side to the area of the piston's retract side.

By F = P x A, the piston extension force at pressure is 50 bar is $50 \times 100000 \times 2.010619 \times 10^{-4} = 1005.31$ N, where 1 bar is converted to 100000 N/m^2.

	Area (m^2)	Supply pressure (bar)				
		10	20	30	40	50
Extension Side	2.010619×10^{-4}	10	21	31	41	51
Retraction side	1.225×10^{-4}	16	34	50	64	82

The pressure reading on the retract side calculated using the same equation:

P = 1005.31÷ 1.225×10^{-4} = 82.066 Bar.

There are some assumptions during the calculation, which include ignoring piston effectivity (85%-95%), and the pressure difference between two distinct points on the tank is negligible.

Figure 61 Pressure reading of the oil tank

The second exercise aims to practice the connection between hydraulics, directional-valve and pipe. The two ends of the single acting hydraulic cylinder are crossly connected to the two points on the oil pressure-flow director. This is because it would be easier to damage when block bounds, if it is connected in parallel. There is also a 4/2-way hand-lever and spring return on the director device. The P point on the director device is connected to the power output and the T point is connected to the oil tank. The working procedure of the director is as follows.

Comment from Assessor

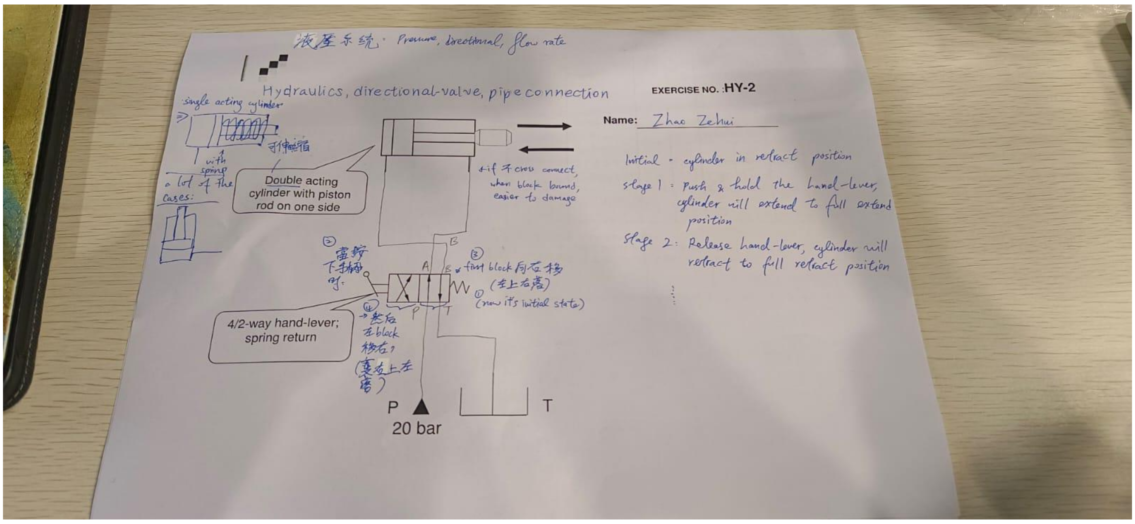


Figure 62 Worksheet of exercise 2

First, when it is in initial state, the oil is flowing from power output, through point A and into the pressure extension side of the cylinder, and flowing out of the cylinder, through point B and into the oil tank. When the hand-lever is pushed downwards, the block on the right-hand side moves to the right, so the oil is flowing from the power output to the hydraulic cylinder through point B and back to the oil tank through point A.

The exercise process has gone through 3 stages. In the initial stage, the hydraulic cylinder is in retract position. At stage 1, we push and hold the hand-lever, then the cylinder will extend to full extend position. At stage 2, we release the hand-lever, then the cylinder will retract to a full retract position.

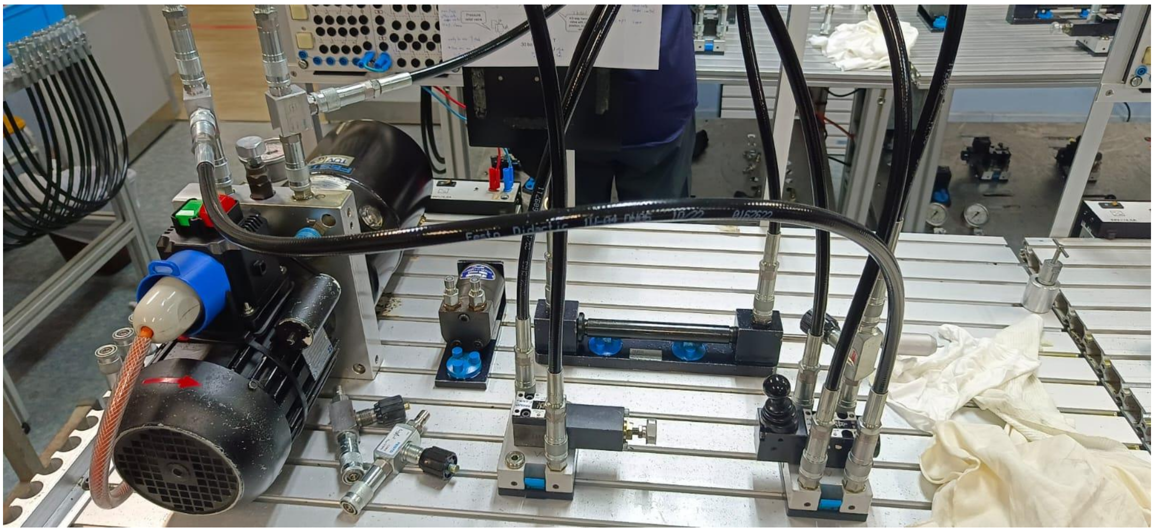


Figure 63 Setup for exercise 2 using double acting cylinder with piston on the one side

Comment from Assessor

Figure 64 4-2 way hand lever, spring return

The third exercise aims to learn about hydraulics and speed control with flow-control. In this exercise, a check valve, a throttle valve, a double action hydraulic cylinder and a three-type oil director device are introduced. The check valve has a unidirectional oil flow, the throttle valve is for flow control and the three-type oil director device has a 4/3-way hand-level valve with bypass position and a non spring return. The downward speed of the double action hydraulic cylinder is adjustable. The check valve and the throttle valve can be connected in parallel for controlling the oil flow rate of the return line.

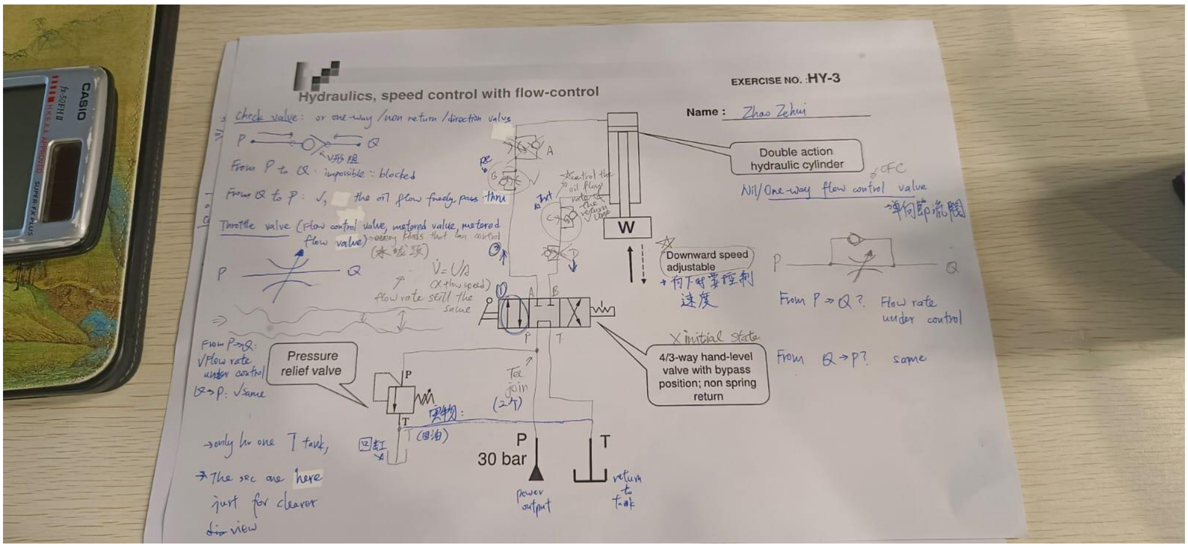


Figure 65 Worksheet of exercise 3

Comment from Assessor

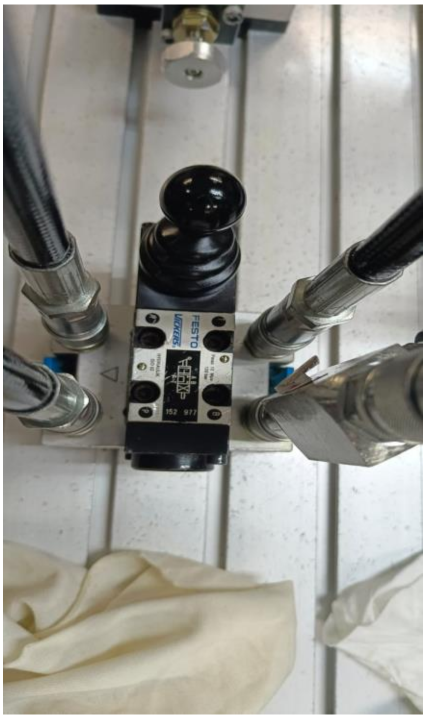


Figure 66 4-3 way hand lever, spring return

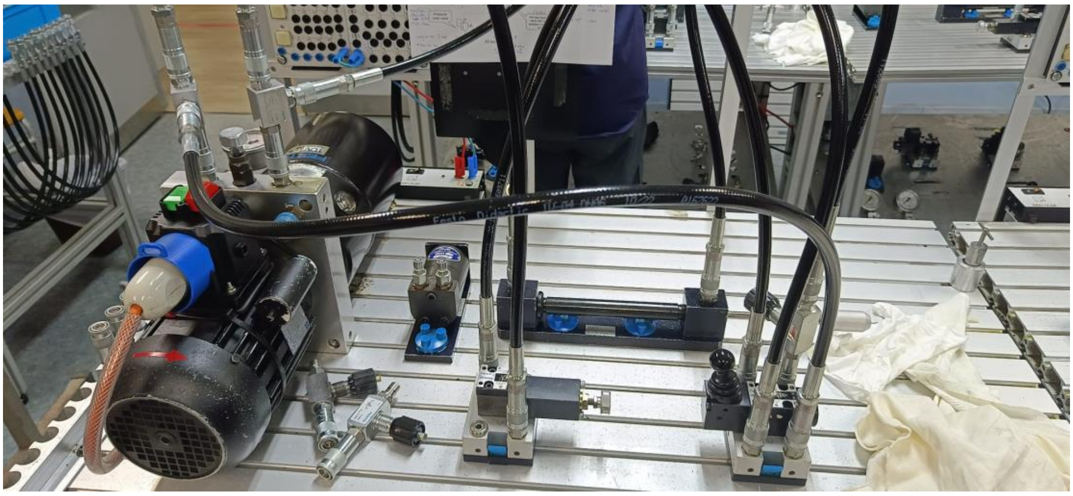


Figure 67 Setup for exercise 3

Exercise 6 Hydraulic, pressure-control valve

In this exercise, we examine the use of hydrualic motor and check valve. The circuit setup is as shown in the worksheet and the diagram below.

Comment from Assessor

Comment from Assessor

Training Activity on Day 2, on 04June 2024

On the second day, we continued hydraulic cylinder practice. Five exercises are attempted. The first exercise is about the use of pressure-control valves. The power output with a power of 20 bar is connected to point A on the pressure flow direction control device and the retract side of the hydraulic cylinder and flows out through point B on the pressure flow direction control device into the oil tank. On the pressure extension side of the cylinder, a hydraulic motor, a pressure relief device and a check valve are connected to the wire which is connected to point A.

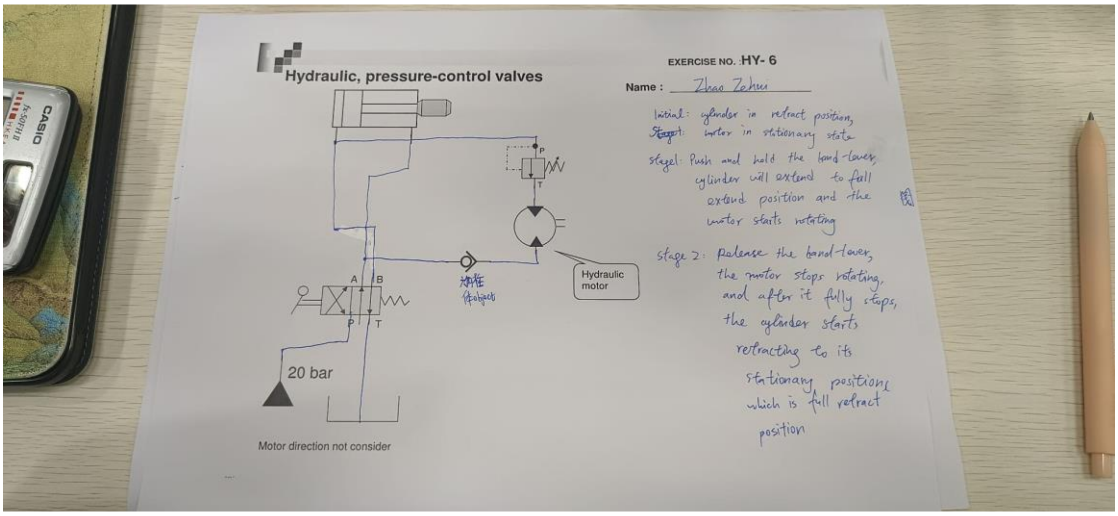


Figure 68 Worksheet for exercise 6, hydraulic, pressure-control valves

Comment from Assessor

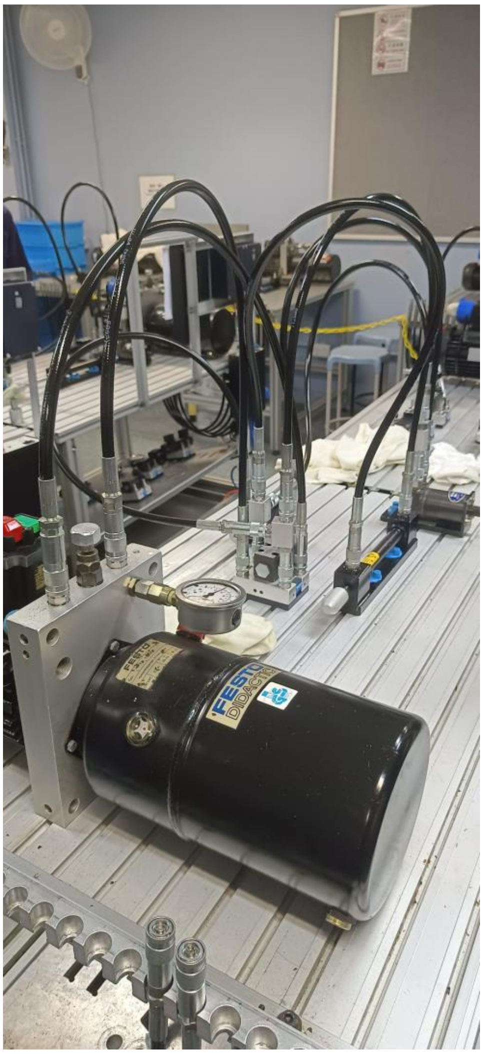


Figure 69 Setup for exercise 6

Figure 70 Hydraulic motor

Comment from Assessor

The exercise process includes three stages. At the initial stage, the cylinder is in retract position, and the hydraulic motor is in stationary state. At stage 1, we push and hold the hand-lever, and the cylinder will extend to full extend position and the motor starts rotating. At stage 2, we release the hand-lever, and the motor stops rotating. After it fully stops, the cylinder starts retracting to its stationary position which is full retract position.

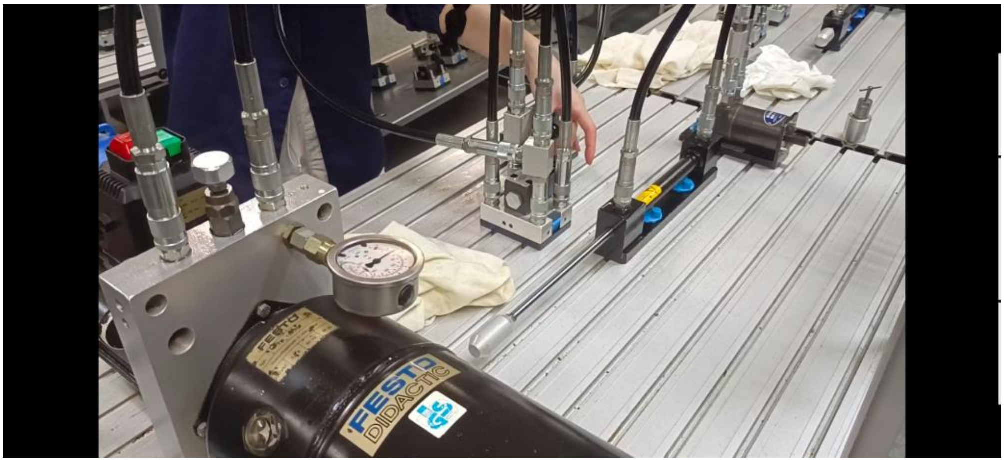


Figure 71 Cylinder in full extend position

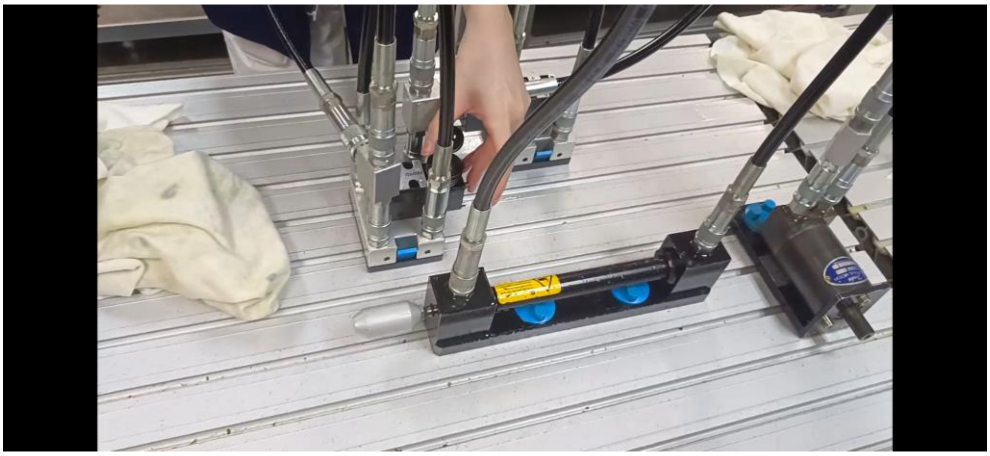


Figure 72 Cylinder in full retract position

There are two types of hydraulic motors discussed during the training. The first one is shown by a drawing of a circle with 2 triangles pointing inwards inside of it. This kind of motor allows oil flowing I two directions (clockwise and anti-clockwise). For the motor with the sign of a circle with two triangles inside of it pointing outwards, it can only bump oil in one direction. The sign of a circle with one triangle in it pointing outwards represents a hydraulic bump which converts kinetic energy to potential energy.

Comment from Assessor

The sign of a circle with an English alphabet “m” represents the hydraulic bump which converts electrical energy to mechanical energy.

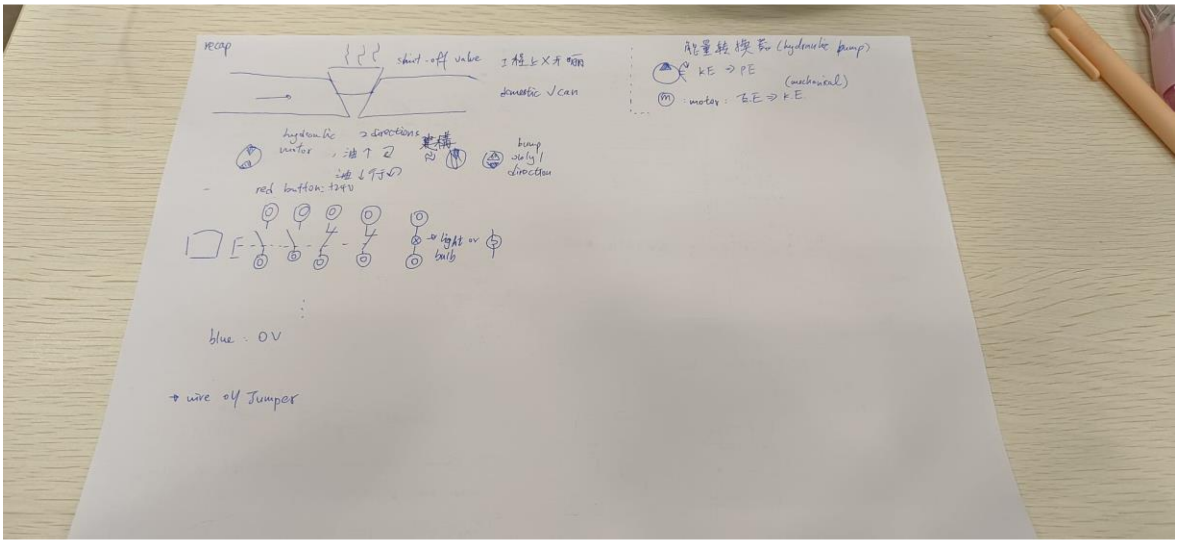


Figure 73 Notes on the types of hydraulic motors, hydraulic pump, and the circuit board introduction

Electro-hydraulic with direct control

The second exercise studies electro-hydraulic with direct control. In this setup, a 4 way 2 position solenoid and a spring return are added on the pressure flow direction controller. The hydraulic cylinder is crossly connected by jumpers to the pressure flow direction controller as less damage will be caused when retrieving accumulated pressure in the cylinder. The power output is in 10 bar. The setup is connected to a circuit board. A trigger switch S1 is used in the circuit. The power supply is 24V Direct-Current circuit. The solenoid Y which is to control the valve is connected with the switch in series.

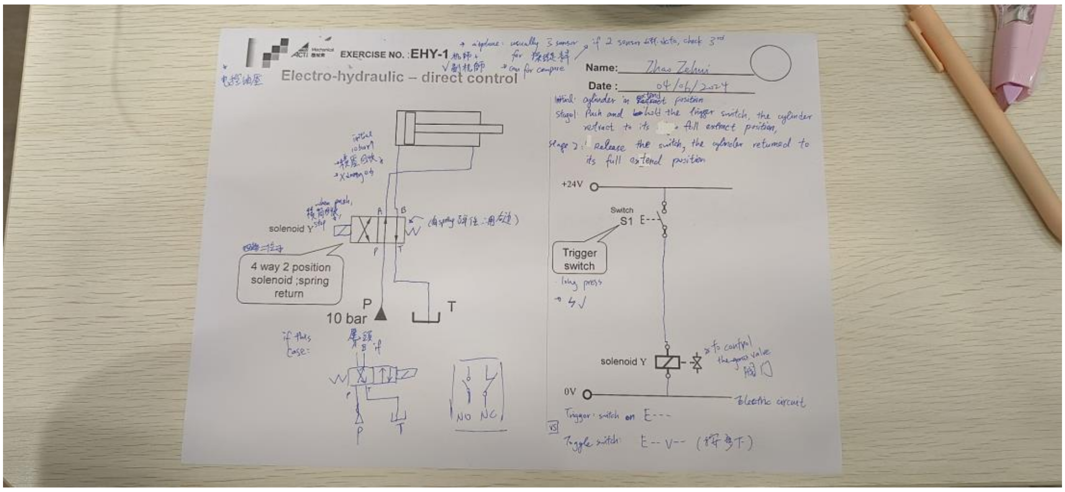


Figure 74 Worksheet for exercise EHY-1, study of electro-hydraulic - direct control

Comment from Assessor

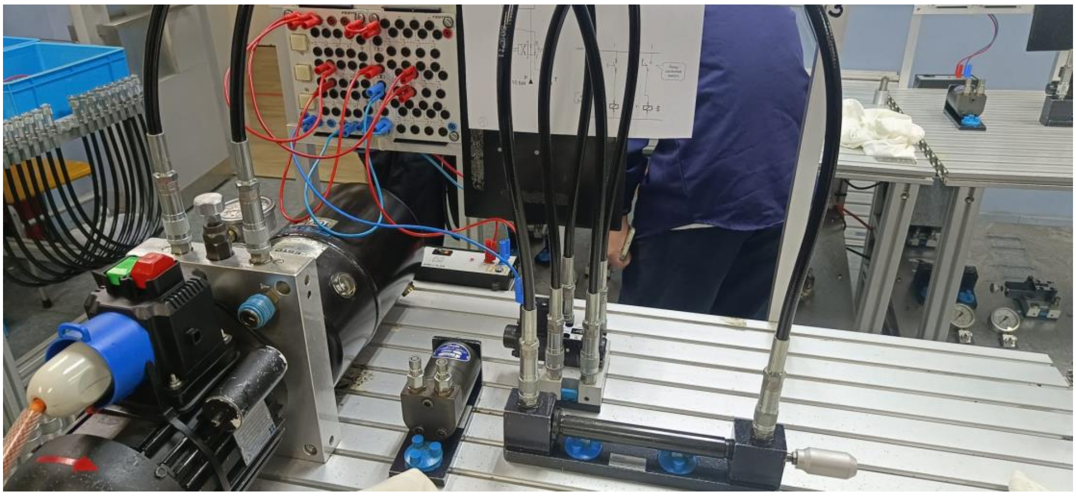


Figure 75 Actual setup for this exercise

Figure 76 A NC switch

There are three stages in the exercise process. At the initial stage, the cylinder is in a retract position. At stage 1, the trigger switch is pushed and held, then the cylinder extended to its full extract position. At stage 3, the switch is released, then the cylinder returns to its full retract position. Other than trigger switch, there is another switch called toggle switch. The main difference between them is that trigger switch is closed when it is pushed once and opened when it is released, while toggle switch is closed when it is pushed and released, and opened when it is pushed and released again.

Comment from Assessor

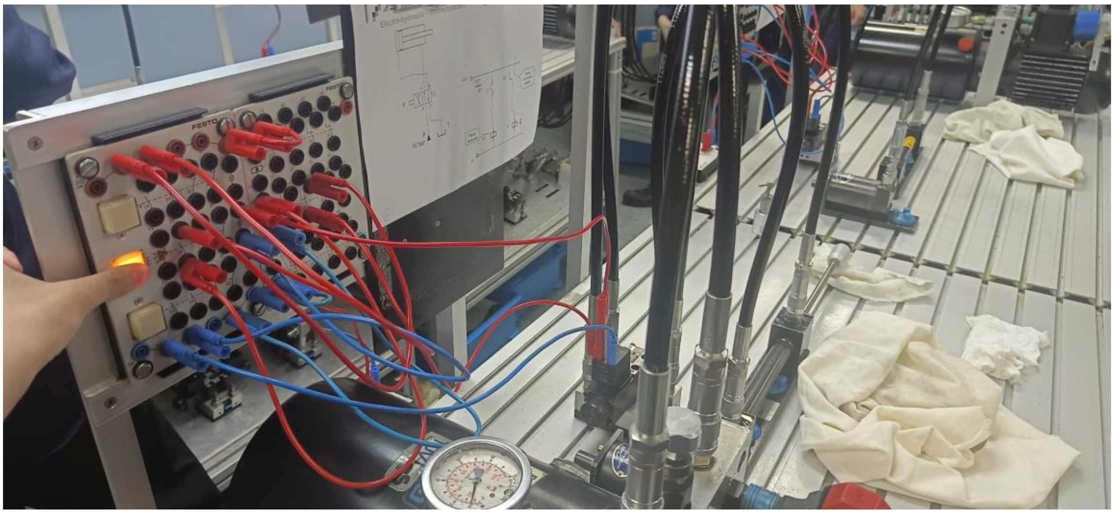


Figure 77 Press and hold the trigger switch. The cylinder is in full extend position. I added an additional connection between the light bulb and the switch such that the light is on, and I press it.

On the circuit board, the cross-sign represents light bulb. The blue wire plugger is 0 V and the red plugger is +24V.

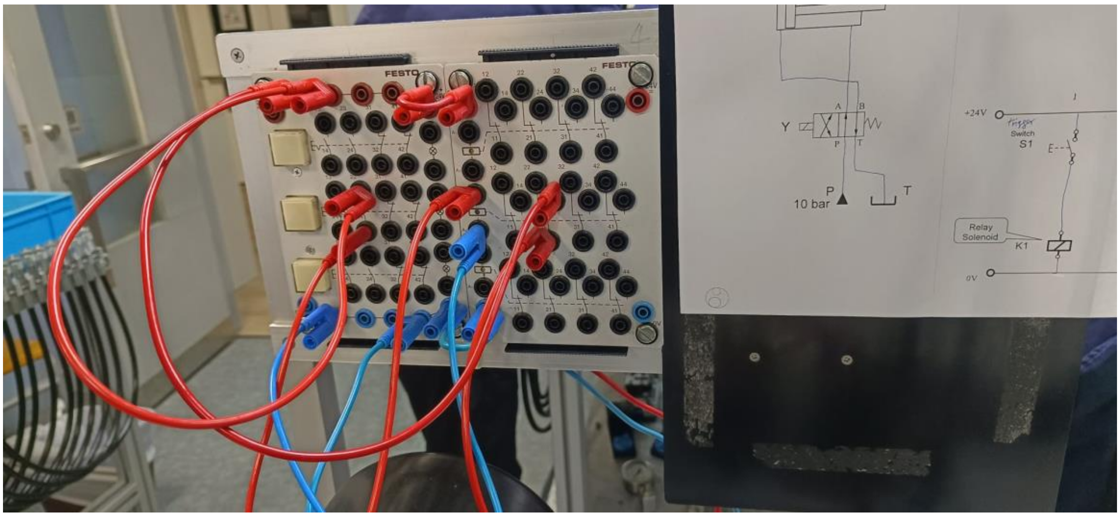


Figure 78 The circuit setup

Electro-hydraulic with indirect control

The third exercise studies electro-hydraulic with indirect control. The setup is the same as the one connected in direct control exercise, but there are two independent circuits connected on the circuit board. On the first circuit, a trigger switch and a relay solenoid K1 is connected in series. On the second circuit, a relay-controlled switch is connected with solenoid Y in series. A relay-controlled switch is used when the system is used multiple times as it can lower the chance of a short circuit occurring. It is commonly

Comment from Assessor

used in the door entrance of a commercial building. The instructions of its use are simple: press the relay-controlled switch and hold it to open the door and release the switch to close the door. The advantage of this mechanism is that it increases the speed of opening and closing of the door, which controls solenoid Y more efficiently, thus increasing the lifespan of Y.

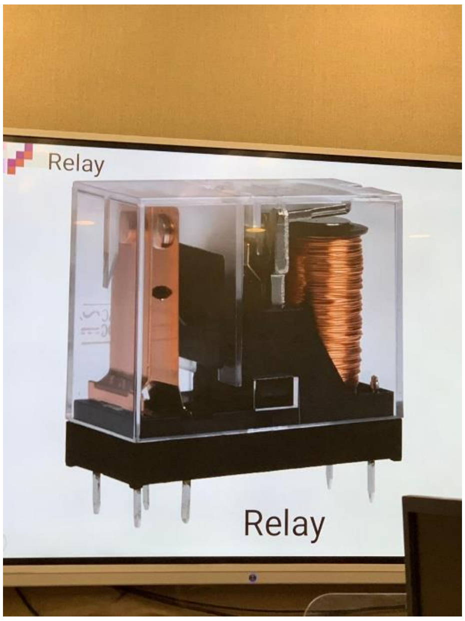


Figure 79 Relay

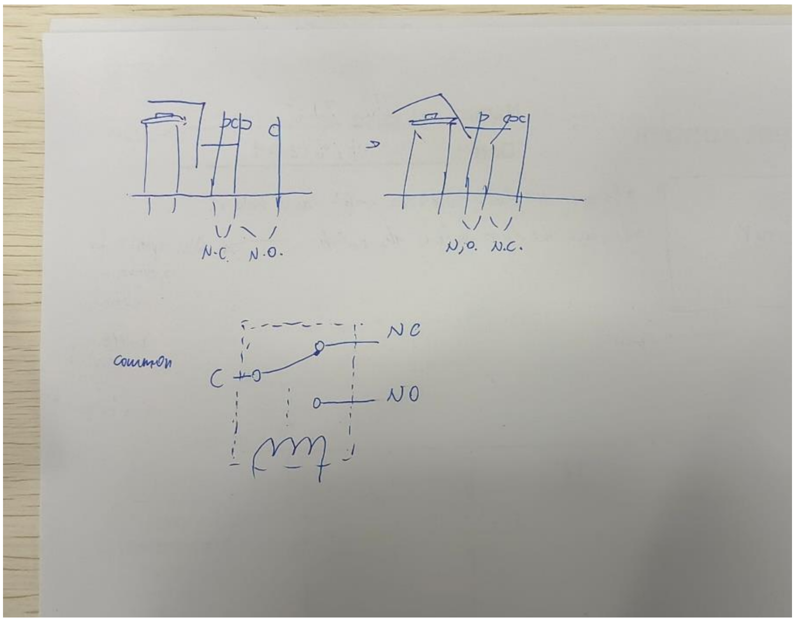


Figure 80 The is the inner structure diagram of the relay-controlled switch.

Comment from Assessor

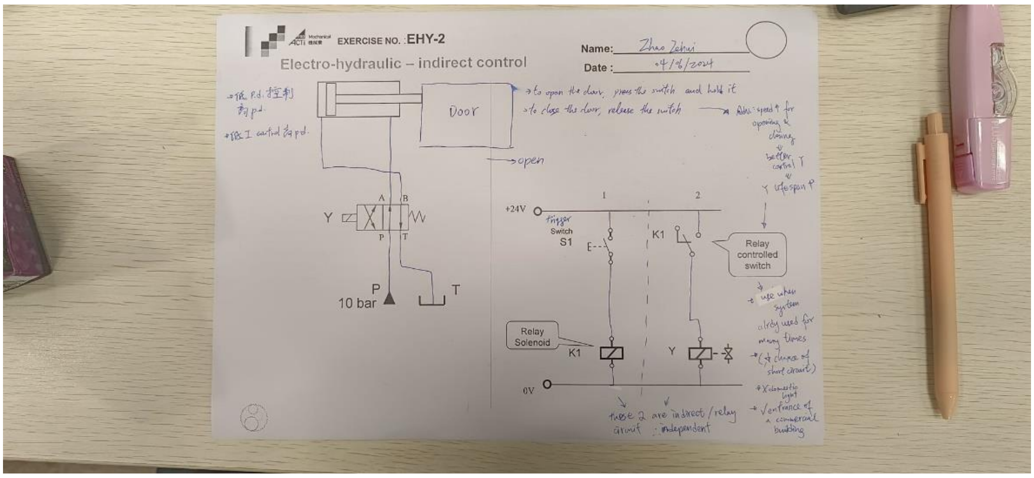


Figure 81 Worksheet for EHY-2

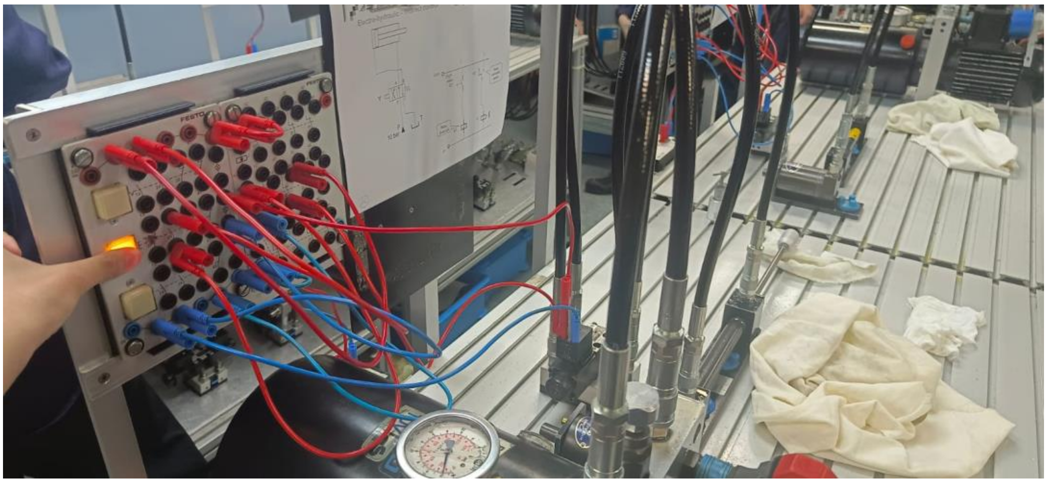


Figure 82 Actual setup for EHY-2 exercise

Figure 83 Two limit switches are used in this setup

Comment from Assessor

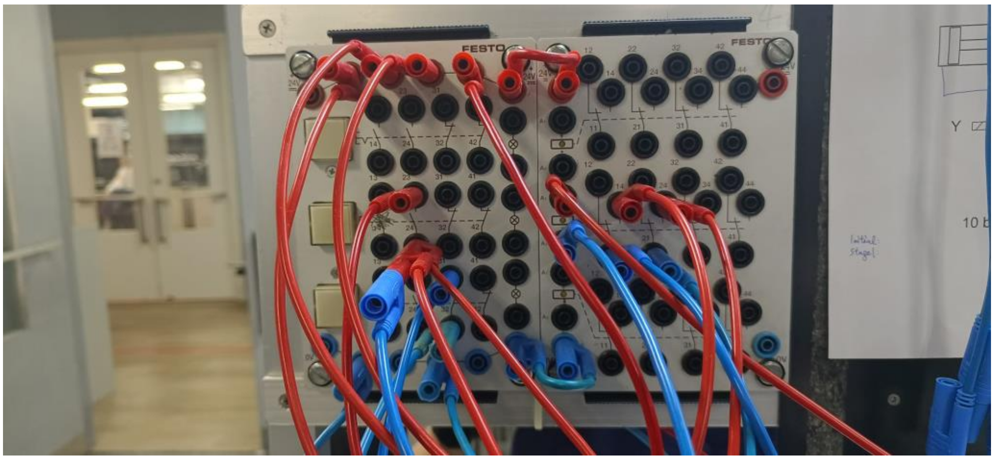


Figure 84 Actual circuit setup

The last two exercise study electro-hydraulic in stroke control.

The main difference between the two exercises is that in stroke control exercise 1, one limit switch is used, while in stroke control exercise 2, two limit switches are used. In stroke control exercise 1, the hydraulic setup is the same as the hydraulic setup in the third exercise, as the testing methods are the same. A limit switch LS1 is placed on the right of the setup to let the cylinder hit it.
In the initial stage of the exercise, the power is not turned on and the cylinder remains at retract position. At stage 1, we press the trigger switch. The cylinder extends until it touches the limit switch and switch it once. Once the switch turns on, the cylinder retracts and turns off the switch, retracting to its full retract position. Thie exercise is the primitive version of an automated system.

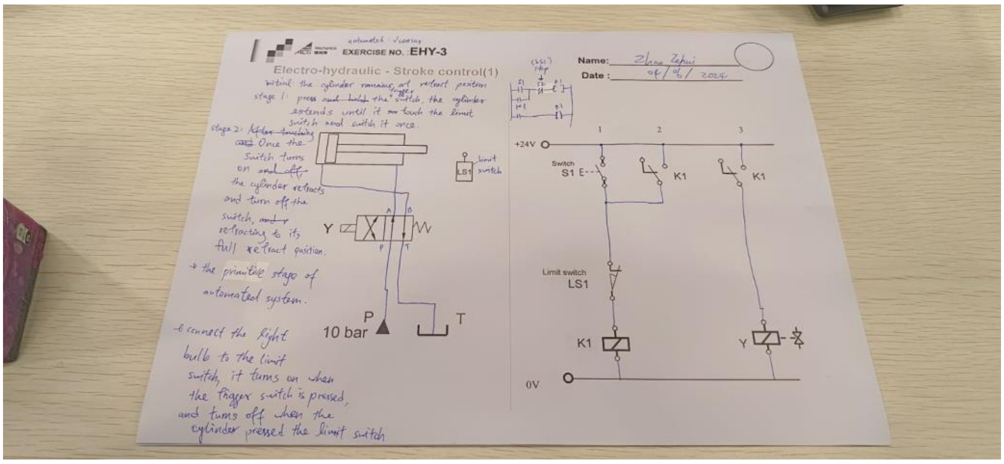


Figure 85 Worksheet for exercise EHY-3, electro-hydraulic - stroke control 1

Comment from Assessor

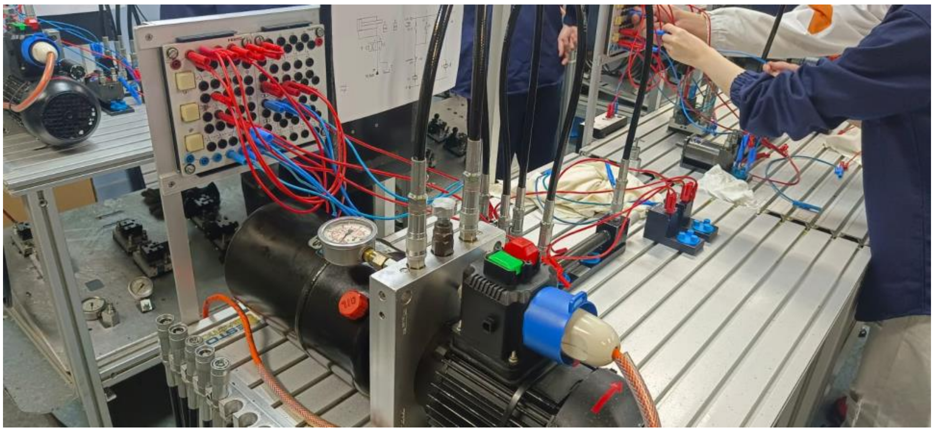


Figure 86 Actual setup for exercise EHY-3, electro-hydraulic - stroke control 1 with two limit NC switches

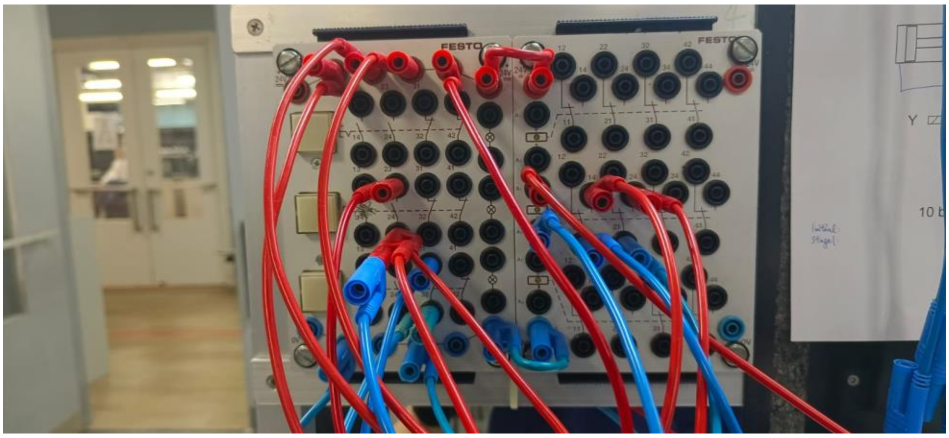


Figure 87 Circuit setup

I added an additional trial to the exercise by connecting the light bulb to the limit switch. When the trigger switch is pressed, it turns on and when the cylinder presses the limit switch, it turns off.

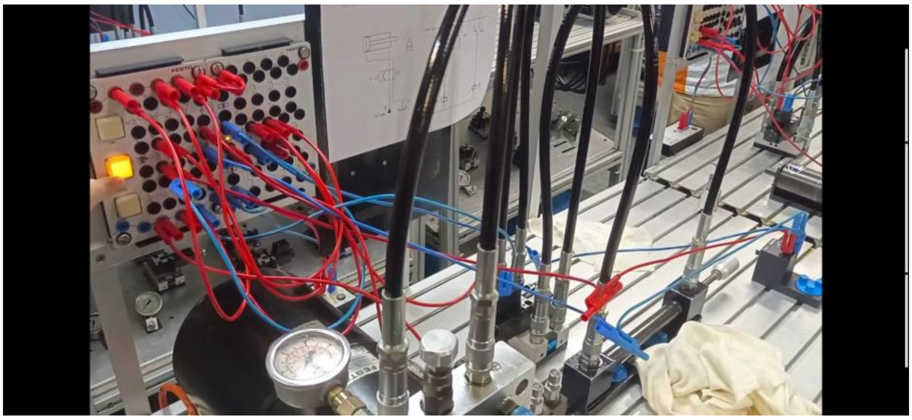


Figure 88 Additional setting

Comment from Assessor

In Stroke control exercise 2, another limit switch LS2 is added to the right of the LS1. On the circuit setup, the trigger switch, limit switch LS2 and the relay control switch are connected from +24V to the limit switch LS1, the relay solenoid and the 0V plugger. The relay control switch is also connected to the solenoid from +24V to 0V plugger.

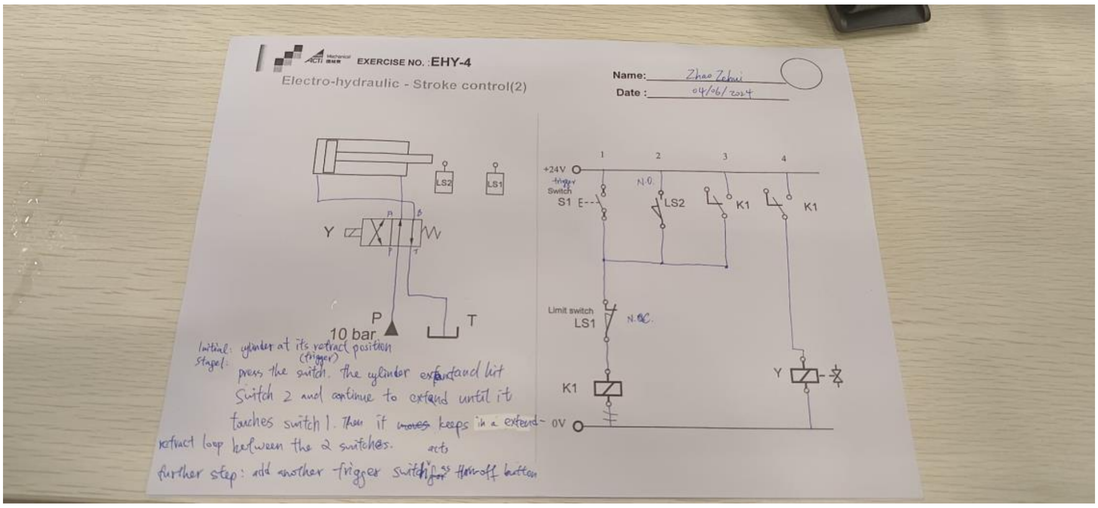


Figure 89 Ciruit diagram for stroke control (2)

At the initial stage, the cylinder is at its retract position. Next, we press the trigger switch. The cylinder extends and hits the limit switch LS2 and continues to extend until it touches switch 1. Then, it keeps in a extend-retract loop between the 2 switches. It retracts to its full retract position when the power is turned off.

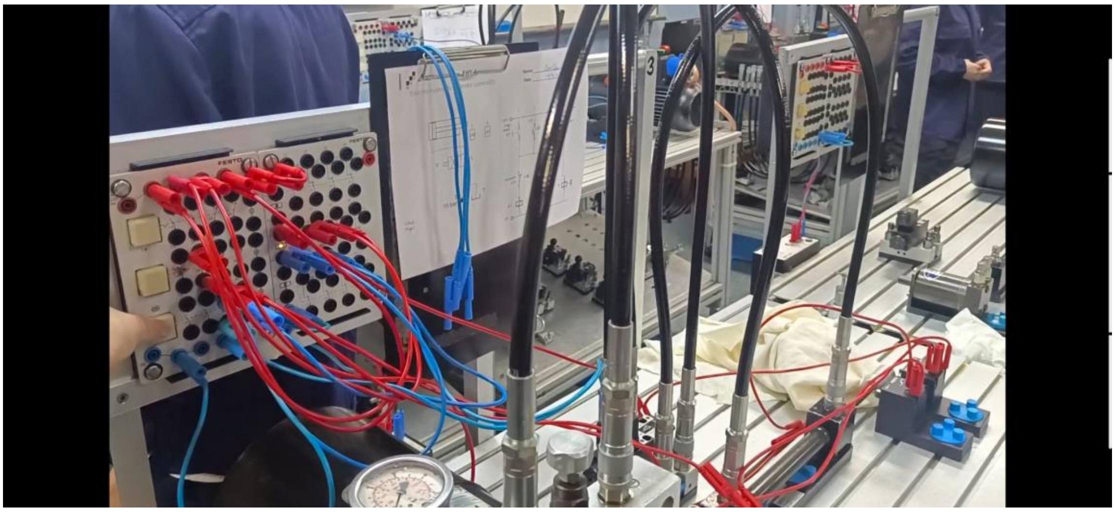


Figure 90 Actual setup for the circuit diagram of stroke control (2) exercise

Comment from Assessor

A further attempt to improve the control of the setup is to add another trigger switch which acts as a turn-off button. After several trials, it is found that the second trigger switch can be connected between relay control solenoid and the 0V plugger, or between limit switch 2 and trigger switch 1 to achieve the effect.

Comment from Assessor

Training Activity on Day 3, on 05June 2024

On day 3, we aim to get familiar with the use of hand tools in Sheet metals and marking out process and appreciate the progress of fabricating sheet metal product. The content of the sheet metal work includes Marking-out, cutting, folding/bending, seaming, wired-edge making and riveting, with the help of different tools, include shearing machine, folding machine, butt welding machine, bench vice, anvil stakes, hand snips, steel rule, try square, scriber, hammer, riveting tool, rivet x 8, steel metal forming tool, diameter of 3.2 mm drill, hand drill and hinge. The exercises are performed in VTC room 405 under the supervision of our instructor, Mr. So.

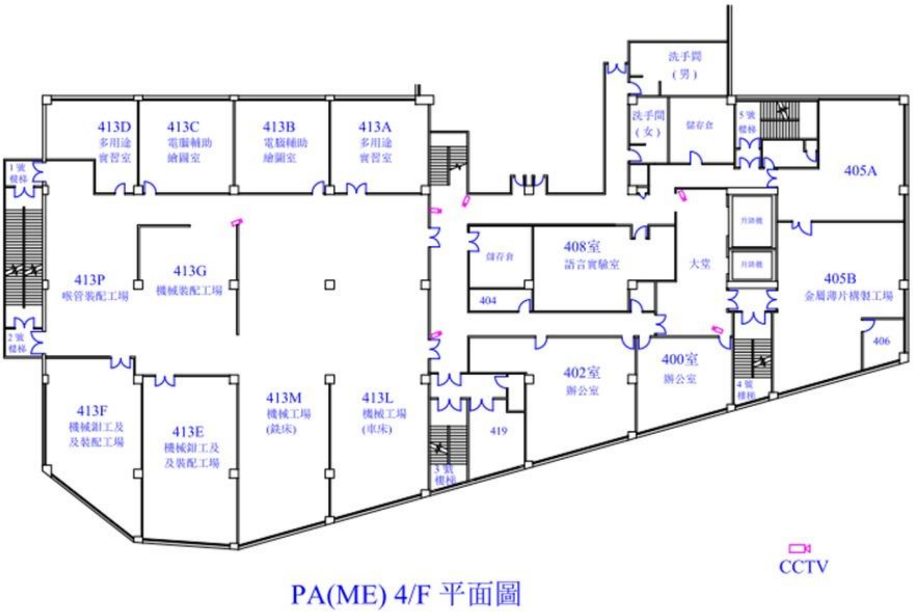


Figure 91 Figure of Floor plan of 4/F

For the first sheet metal work practice, we practiced making different types of seam and edges, including double seam, grooved seam, safety edge, Pittsburgh seam and wired edge.

Comment from Assessor

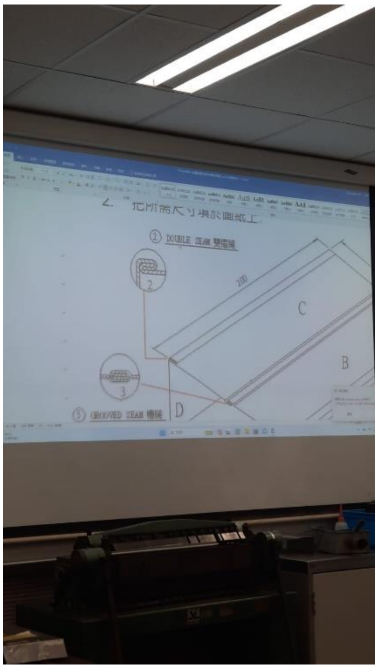


Figure 92 Instruduction of different kinds of seams that are seen in sheet metal work practice

Figure 93 Engineering tools for sheet metal work practice

Comment from Assessor

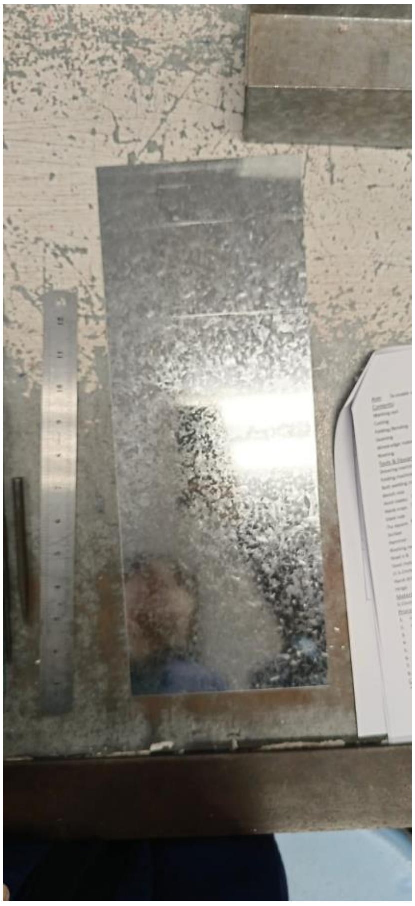


Figure 94 0.55mm thick steel sheet with height of 500mm and width of 200mm

The first step is to use steel rule, try square and scriber to mark out the pattern by cutting the corner of left side, and base-on the dimensions draft the Sheet Metal Box and cover.

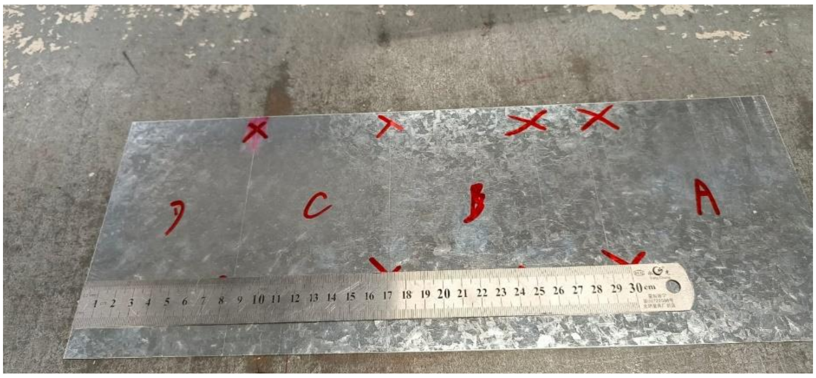


Figure 95 Markings on the metal piece

Next, we use shearing machine to cut the outline for the sheet metal pattern.

Comment from Assessor

Figure 96 Shearing machine with safety rules and reminders

Figure 97 Second type of shearing machine

Comment from Assessor

Figure 98 Cutting the metal piece

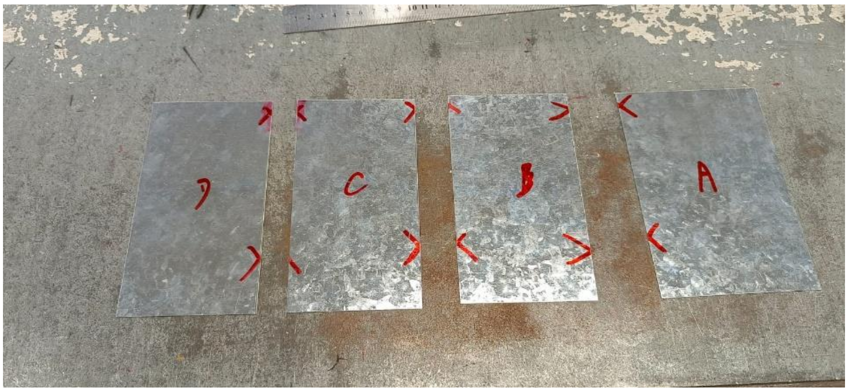


Figure 99 The metal piece is cut into four separate components

We used hand snips to cut the diagonal line pattern. To mold all the metal pieces together to form the sheet metal work, we need to bend edge line of the metal pieces to make “Single Hem” by using hammer, bench vice to stabilize the metal piece and anvil stakes.

Comment from Assessor

Figure 100 Bneding the edge line of the metal piece

Figure 101 Bench vice

Also, a folding machine is needed to bend the short side, edge and the long side to 90 degrees.

Figure 102 Folding machine

Comment from Assessor

After that we used hammer to bend and outline the shape.

Figure 103 Bended seam to lock the metal piece together

The next step is to use a vise to hold the folded edge, then use a butt welder to weld the 3 positions on the edge and finish the other edges.

Figure 104 Welding machine

Comment from Assessor

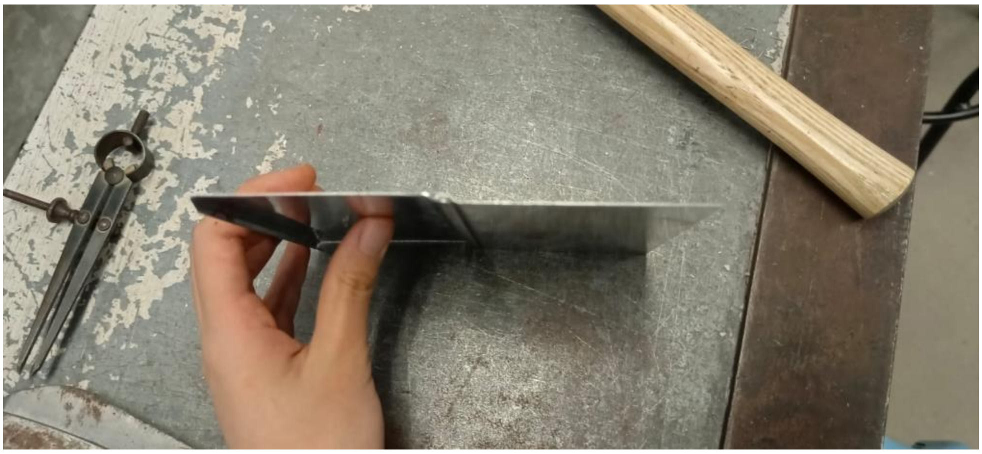


Figure 105 locking the two pieces

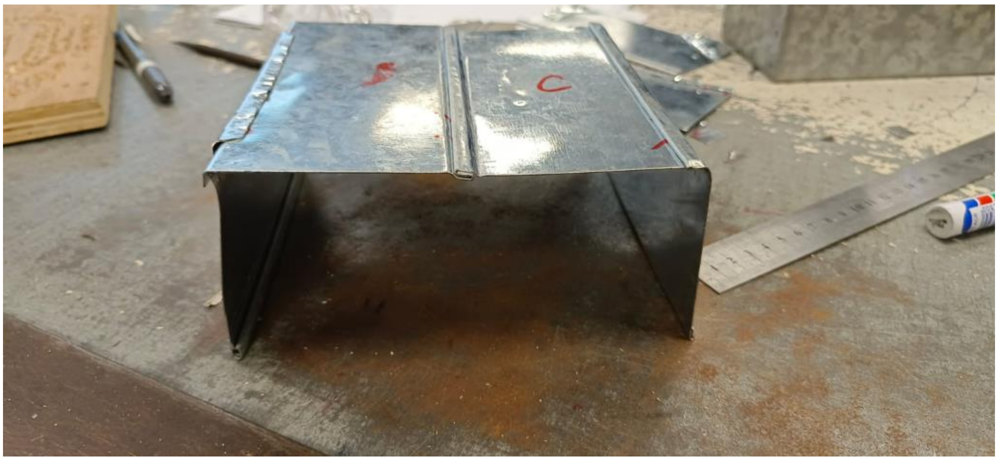


Figure 106 Finished work piece

For the second sheet metal work practice, we are going to make a metal box. We used 0.55mm thick steel sheet with height of 500mm and width of 200mm for the sheet metal work. Similar procedures with exercise 1 are done. Then we removed the burrs from the sharp edge and corner using the flat file and hammer for safety. The body part of the box is finished. Moreover, for making the cover of the box, we also used folding machine to bend the sheet metal edge to make a “Single Hem”. Then, we used a hammer, bench vice, anvil stakes to further outline the hem. By using the same tools, we bend the sheet metal edge to make “Double Flange” of the box cover 3 side.

Comment from Assessor

Figure 107 Metl box cover

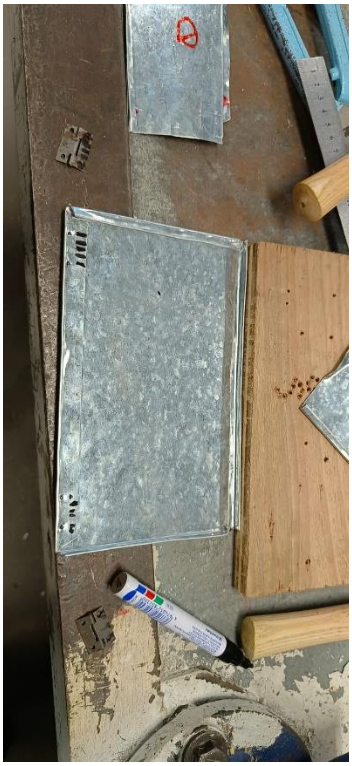


Figure 108 Then we used steel rule and scriber to mark a hinges position on the box and cover.

Comment from Assessor

Figure 109 we used a hand-drill to make 4 holes of diameter of 3.2mm on the box and the cover.

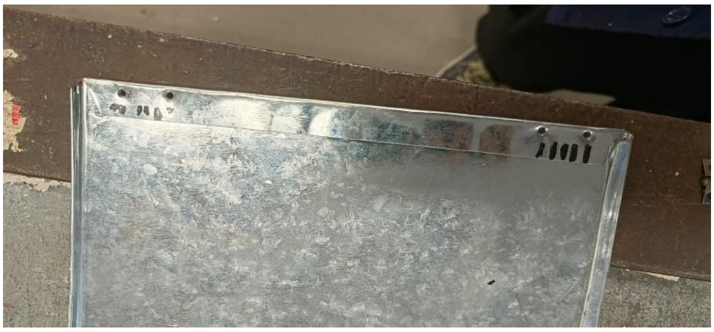


Figure 110 Holes on the metal cover for hinge

Figure 111 Riveting tool

Comment from Assessor

Training Activity on Day 4, on 06June 2024

On the fourth day, we aim to get familiar with bench fitting and marking out process, appreciate the process and learn to operate a drilling machine safely. The exercises are performed in VTC room 520 under the supervision of our instructor, Mr. KY So. The training sessions various kinds of equipment, including bench vice; surface table; Vertical drilling machine vernier caliper, 150mm, 0.02 grad; vernier height gauge; v-block; angle plate; steel rule; try square; spring divider; centre punch; hammer; hand vice; files; hacksaw and tap wrench.

Fitting

These are the required equipment for fitting.

Figure 112 Equipments from left to right: Steel rule, files, centre punch, hammer, hacksaw, the metal workpiece and a bench vice

Figure 113 Training room for Day 4&5

Comment from Assessor

First, we measure the metal piece with steel rule, then mark the position with a centre punch.

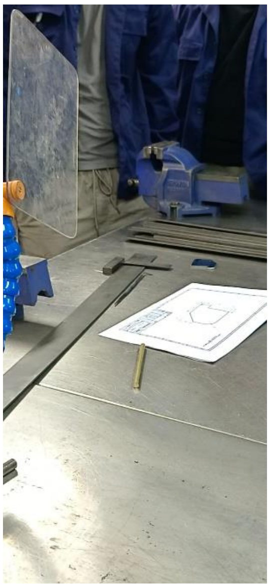


Figure 114 Metal piece to be cut

Figure 115 Next, we stabled it on a bench vice

Comment from Assessor

Figure 116 Cut it into the length we measured using a hacksaw.

Figure 117 The cutting path of hacksaw

Comment from Assessor

Figure 118 Use files to remove fine amounts of material from the edge of the workpiece.

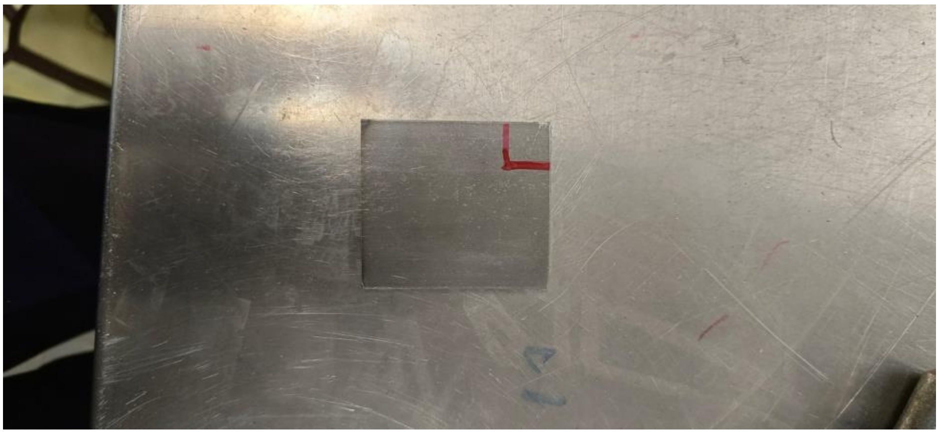


Figure 119 Mark the shape that is to be cut by a hacksaw with marker pen.

Comment from Assessor

Figure 120 To make a more precised measurement of the region we need to cut, we used an angle plate to keep it stay vertical on the table, then use a vernier height gauge to measure the length and mark it.

We used files, hammer and hacksaw to further modify the shape.

Figure 121 The final shape of the workpiece.

Comment from Assessor

Drilling

Each of us is given an aluminium workpiece to practice drilling. We measure the distance of each hole that needs to be drilled on the workpiece using an angle plate, a steel rule and a vernier height gauge, then place it on a vertical drilling machine.

Figure 122 Drilling machine

Figure 123 Drilling the aluminium workpiece

Comment from Assessor

Figure 124 Lubricate oils need to be added throughout the drilling process to removing the metal fillings and reduce the frictional force between the workpiece wall and the screw.

The centre hole of the workpiece is ø8 mm, the four holes on the four corners are ø10, ø12, M5x1 and M8x1.25.

Figure 125 Making countersink using the central drill

Comment from Assessor

Figure 126 The finished workp piece

Tapping

Lastly, we used first tap, secondary tap and bottom tap respectively to do tapping on the wall of the holes.

Figure 127 Tap wrench for tapping

Figure 128 For stabalising the wrench during tapping

Comment from Assessor

Training Activity on Day 5, on 07June 2024

On this final day, the instructor demonstrated to us each main component of the vertical drilling machine. The brand of the machine is Shanghai H5-3C, and the largest diameter is 25mm. There are several components that can be calibrated to meet the drilling requirements

Figure 129 A handle for moving it up and down

There’s also a formula for controlling the speed of the rotating drills, which will be further introduced in machine practice.

After this session, we moved back to the metal box process to finish the final procedures in VTC room 520. Under the supervision of our instructor, Mr. So, we used metal hammers to modify the shape of the box and the cover

Comment from Assessor

Figure 130 Centre punch to marke the holes of the metal box

Figure 131 Drilling holes on the metal box

Comment from Assessor

Figure 132 Using rivet gun to fix the hinge joint on the box and cover and mold them

Figure 133 The finished metal box

Comment from Assessor

Training Module: Basic Electrical Engineering

Training Module:	Basic Electrical Engineering	Student Group Attended:	ME1
Training periods	From 11June to 15June		

Training Activity on Day 1, on 11June 2024

On the first 2.5 days of the training, we were about to build 6 electric board and measure the values shown on the oscilloscope. One the first day of training, we are informed with the safety floor plan from our instructor Mr. Mok To Man, in Composite Building LG room 206.

Figure 134 Two power supplies, a waveform generator and an oscilloscope

Comment from Assessor

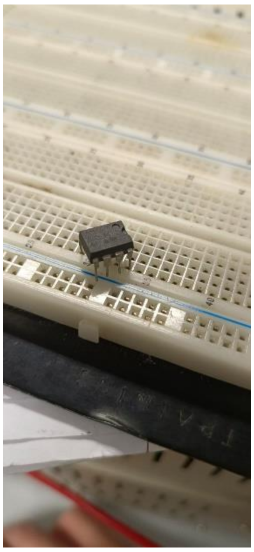


Figure 135 LM741 Operational Amplifier

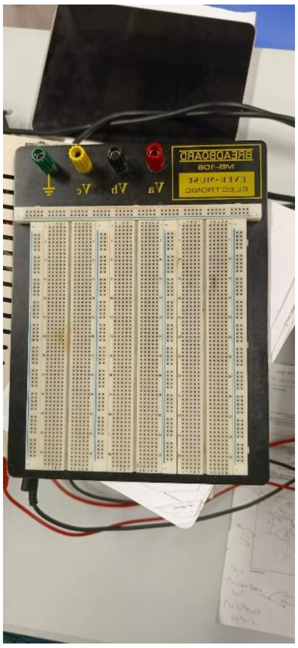


Figure 136 Breadboard

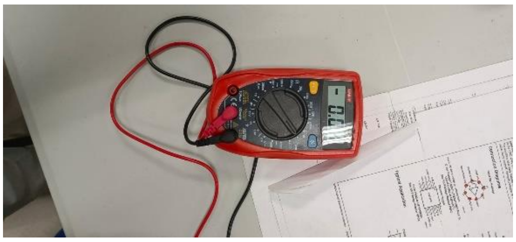


Figure 137 Multimeter

Comment from Assessor

Figure 138 Trivot joint

Figure 139 Wires

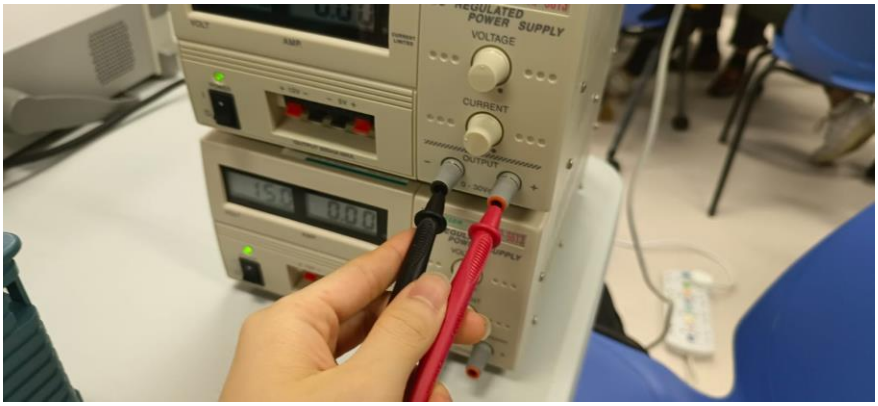


Figure 140 Setting the power supply value

We first got familiar with the use of LM741 Operational Amplifier, its connection diagram and its absolute maximum ratings. An operational amplifier is an analog electronic device that is commonly used in various electronic circuits and applications. Then we studied the block diagram which shows the overall set up for oscilloscope, two power supplies, signal generator and electric board.

Comment from Assessor

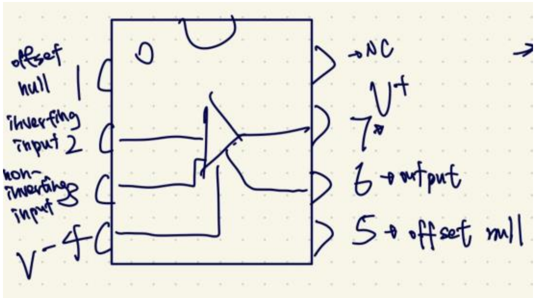
The equation for operational amplifier is

$$V_{out} = G(V^{-} - V^{+})$$

Where G is the value gain at around 10^5. The value of G is set by the manufacturer already, but the value of V^{-} and V^{+} can be modified through the operational amplifier.

On a closer look of the operational amplifier, on the left side of it includes offset null at 1, inverting input on 2, non-inverting input on 3 and V^{-} on 4. On the right side of it includes an offset null at 5, output at 6, V^{+} at 7 and NC at 8.

In the block diagram, the signal generator is connected to C.C.T. (circuit) using a BNC type wire, which is Vin, and with a T-type joint as another end of it is connected to the oscilloscope. Two power supplies are connected to the circuit. The Voutput is the wire connected from C.C.T. to the oscilloscope. Vin is the signal sending in the circuit and check if the system works or not.



Inverting operational amplifier

The first circuit we worked on is the inverting operational amplifier. A Rin resistor is connected in series with the operational amplifier, which is at the inverting input (2) on its left hand side. The current passes through Rin is I^{-}. Another resistor Rf is connected in parallel with the operational amplifier. The current passes through resistor Rf is If. There is also a resistor R2 connected at 3, the non-inverting input of the operational amplifier to the ground. The current passes through R2 is I^{+}. The joint of Rf and operational amplifier has a virtual ground so the voltage here is 0. At inverting input, the voltage value is $V^{-}$and the voltage value at non-inverting input is V^{+}. $V^{+}$is 15V and $V^{-}$is -15V. The resistor Rin and R2 have the same resistance (1k Ohm) such that the difference between I^{+} and I^{-} is 0. The voltage measured at Vout is also 0.

These are the equation about the circuit:

Vin – V^{-}= Vin

Comment from Assessor

Iin = Vin/Rin

(0- Vout)/Rf = If

Iin + I^{-}= If

Vout = -Rf/Rin Vin

We can see the voltage change as the frequency change.

1 Vpp	Frequency = 1k Hz	Frequency = 10kHz	Frequency = 15kHz	Frequency = 20kHz
CH1 Pk-Pk	5.60V	5.4V	5.20V	5.20V
CH2 Pk-Pk	11.2V	11.0V	11.0V	11.2V
5 Vpp	Frequency = 1k Hz	Frequency = 10kHz	Frequency = 15kHz	Frequency = 20kHz
CH1 Pk-Pk	5.60V	5.4V	5.20V	5.20V
CH2 Pk-Pk	11.2V	11.0V	11.0V	11.2V

The shape of different waveform changes in terms of amplitude and frequency.

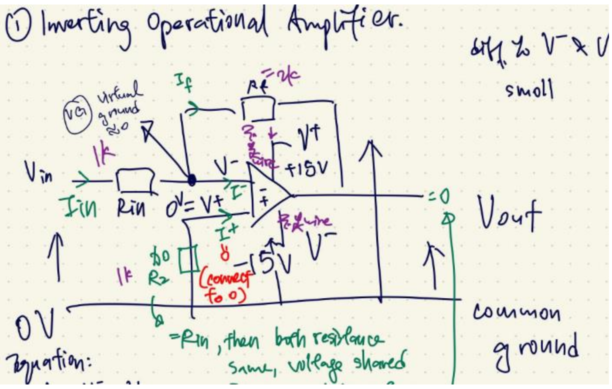


Figure 141 Circuit diagram

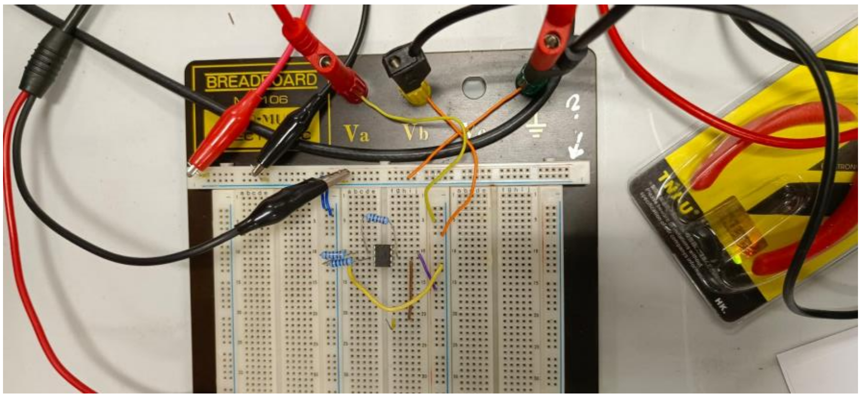


Figure 142 Circuit setup for in verting operational amplifier

Comment from Assessor

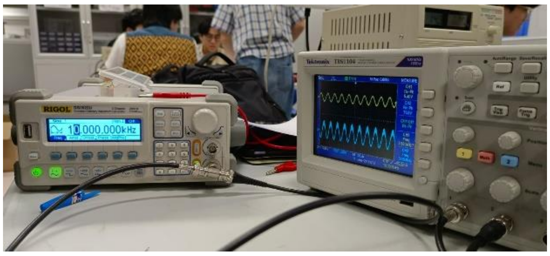


Figure 143 Frequency is 10kHz

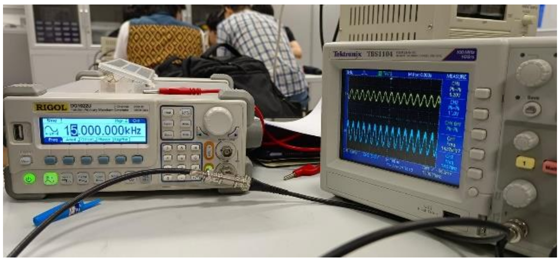


Figure 144 Frequency is 15kHz

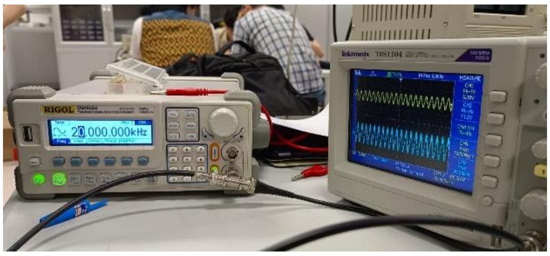


Figure 145 Frequency is 20kHz

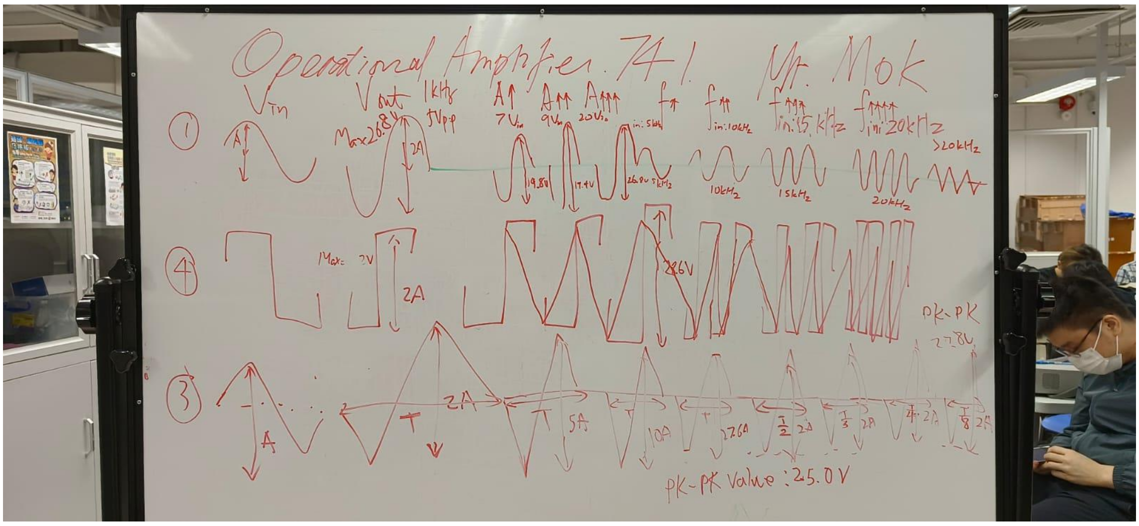


Figure 146 Comparison of different shapes of waveform when amplitude increased and frequency increased.

Comment from Assessor

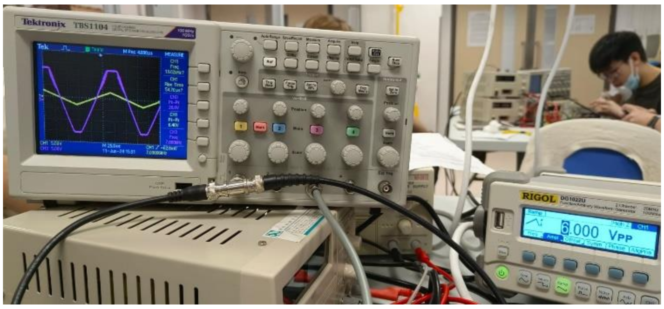


Figure 147 Maximum value for amplitude

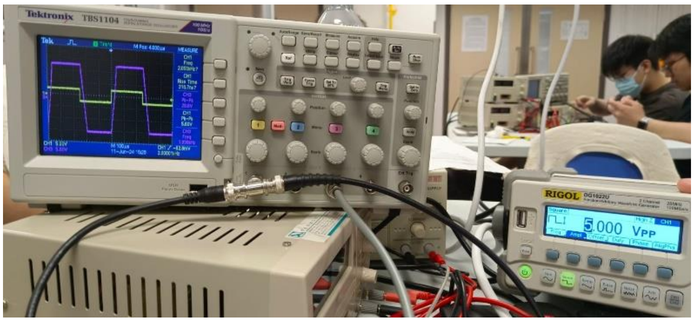


Figure 148 Largest value of the waveform

Comment from Assessor

Training Activity on Day 2, on 12June 2024

On the second day of the training, we burnt out three operational amplifiers when we modified the circuit. After examination, we concluded that the inner construction part of the circuit board is burnt, as it has been burnt by pervious students several times.

Figure 149 The three burnt out operational amplifier

Non-inverting operational amplifier

The second exercise we do is a non-inverting amplifier. The signal is directed to the positive input of the operational amplifier, while the negative input is attached to the output via resister Rf and grounded through resister RL. This circuit configuration allows a gain in VOUT/VIN, which is equivalent to 1+Rf/RL. In this circuit configuration, I^{+}=I^{-}=0, V^{+}= V^{-}, Iin = IL+If. So VOUT = Vin((Rf+RL)/R2).

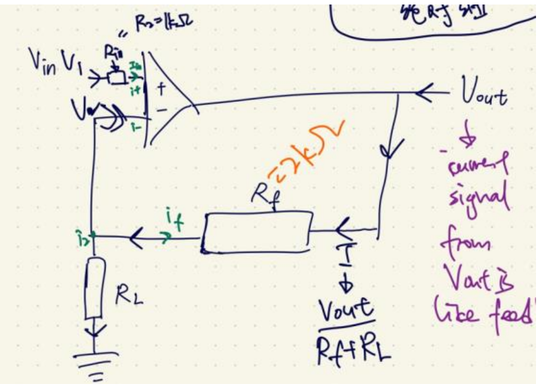


Figure 150 Circuit diagram of non-inverting operational amplifier

Comment from Assessor

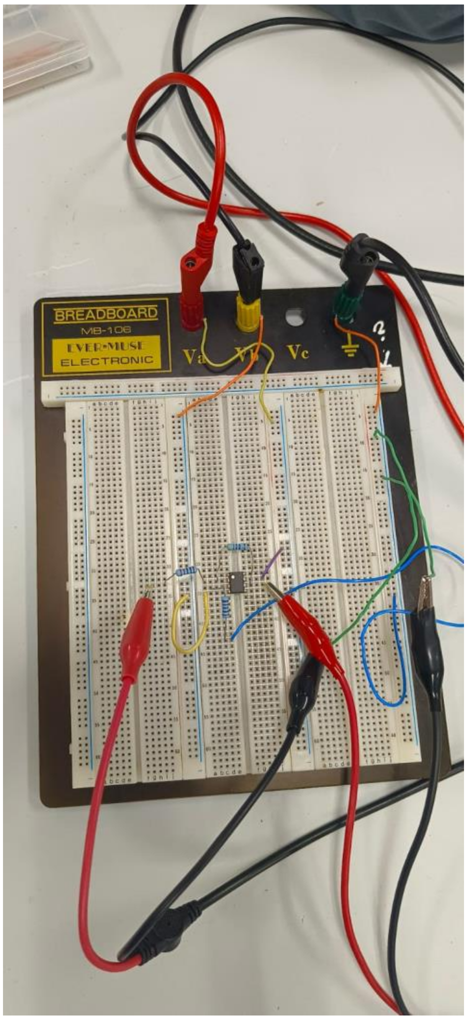


Figure 151 Circuit setup for non-inverting operational amplifier

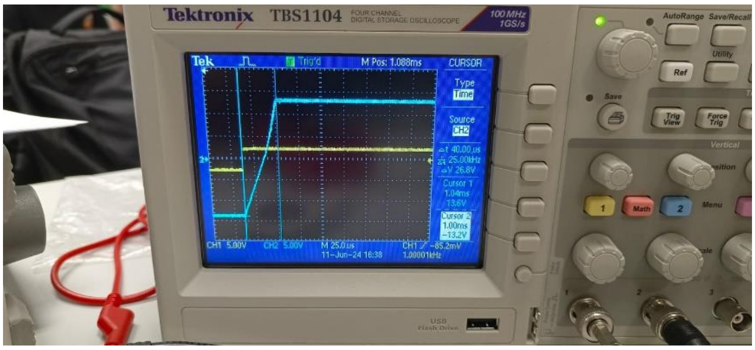


Figure 152 Measuring the slew rate of the waveform. It can be calculated by delat V/delta time. Slew rate affects the ratio of the value of the crest to that of the trough.

Comment from Assessor

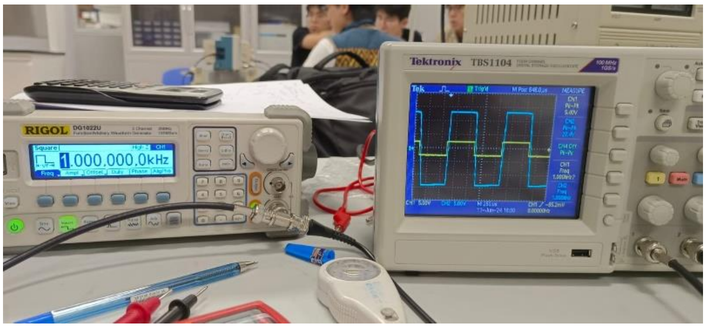


Figure 153 Square waveform. We observed when frequency increased, the amplitude of the voltage output decreased.

Inverting integrator

In this configuration, VOUT is not affected by capacitance and resistance since they act as constant. It is the sum of Vin with respect to the rate of change of time, and VR = 0-VOUT. From the table of results, we concluded that the amplitude of output is decreasing while the frequency is increasing. We see that when the capacitor stores power, the output waveform diminishes. Moreover, regarding the slew rate of the waveform, we know that the value of frequency is indirectly proportional to that of VOUTPUT.

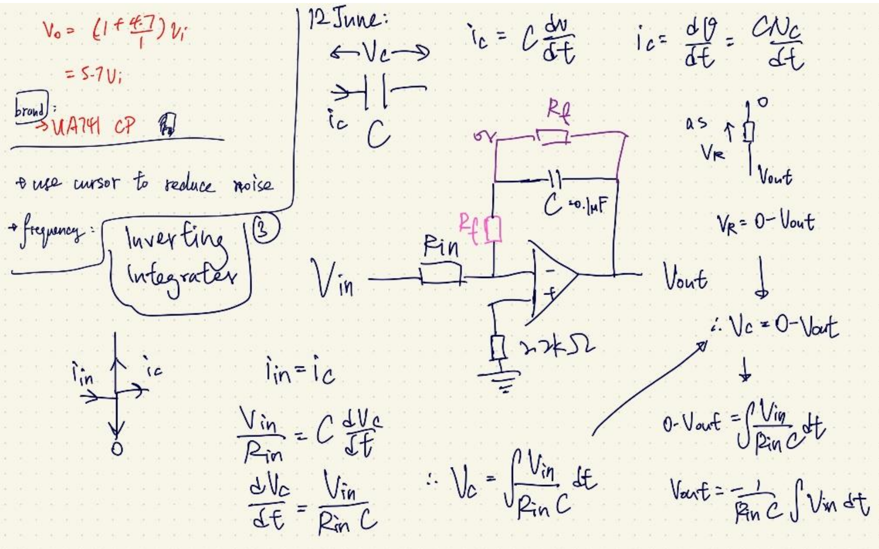


Figure 154 Notes on circuit drawing diagram and equations for Inverting integrator

Comment from Assessor

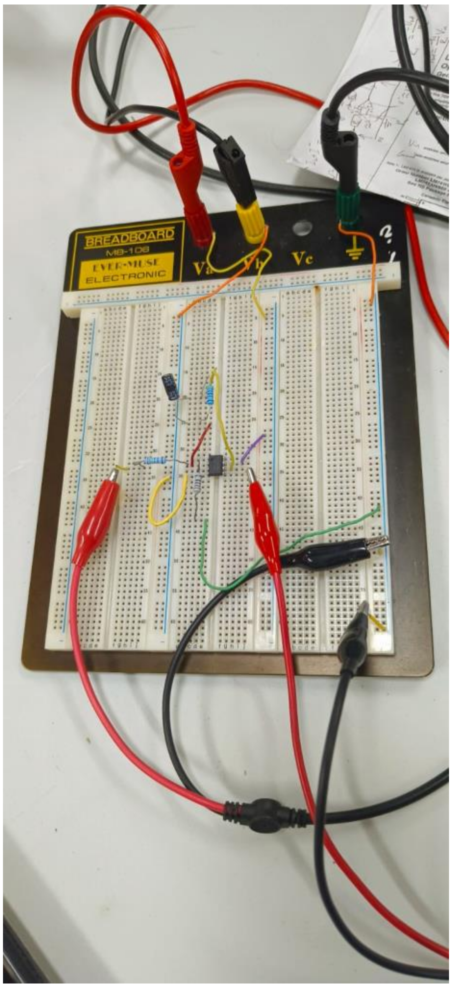


Figure 155 Inverting integrator

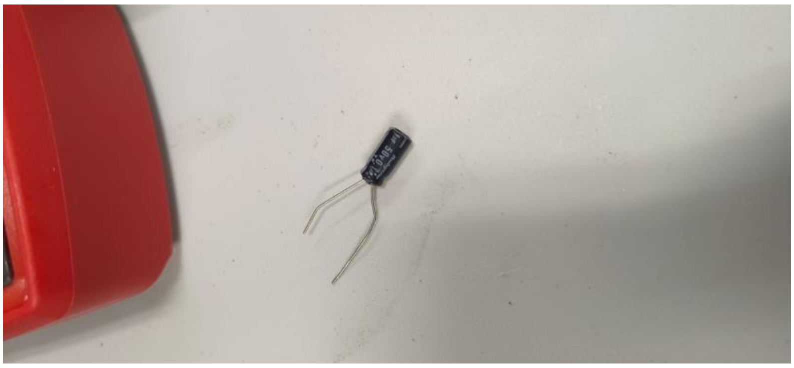


Figure 156 Capacitor

Comment from Assessor

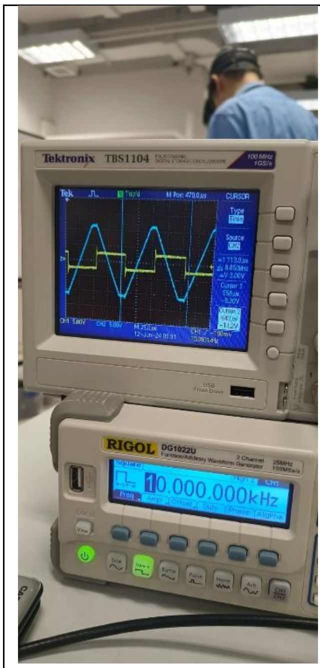


Figure 157 Maximum difference in voltage value between two waveform channels

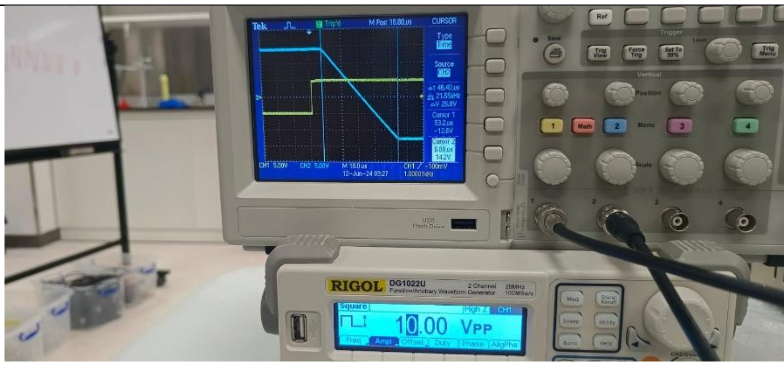


Figure 158 Minimum difference in voltage between two waveform channels

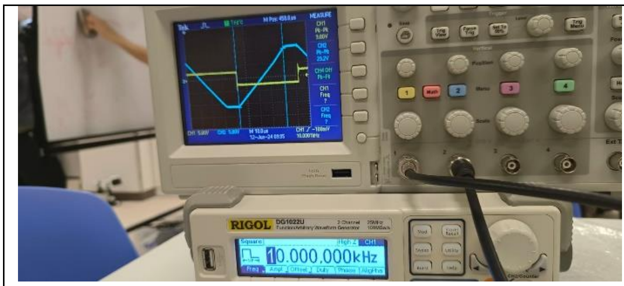


Figure 159 Maximum peak-to-peak value of channel 2

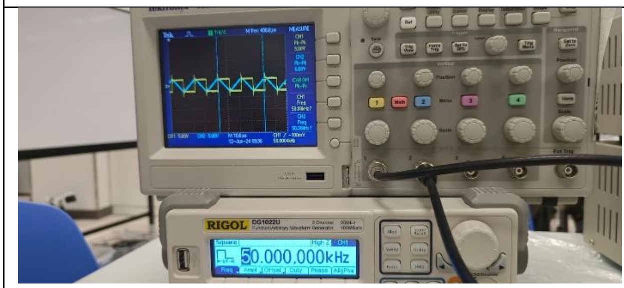


Figure 160 Minimum peak-to-peak value of channel 2

Comment from Assessor

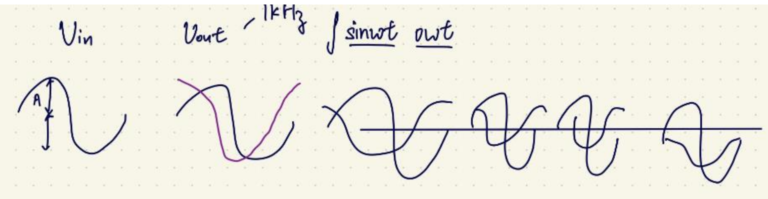


Figure 161 Waveform graph drawing as frequency increases

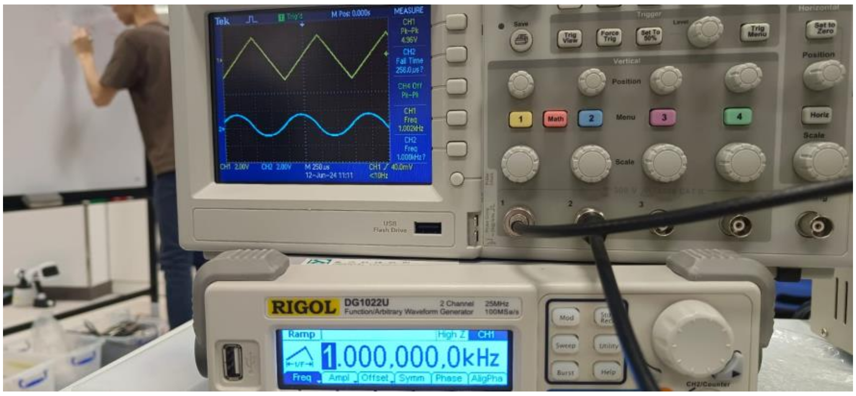


Figure 162 Waveform shown on the oscilliscope when frequency is 1kHz

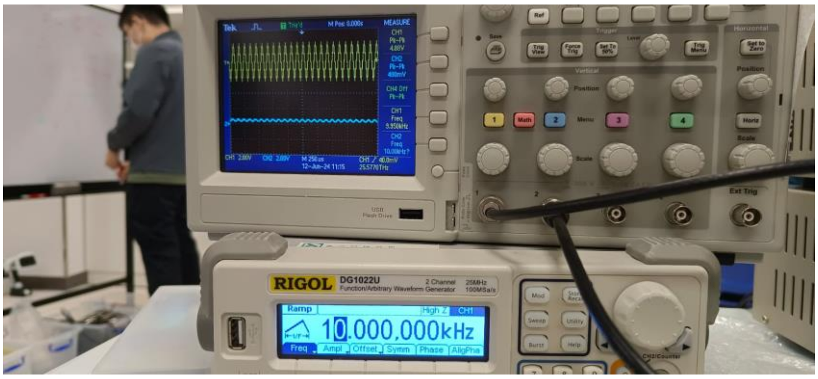


Figure 163 Waveform when frequency is 10kHz

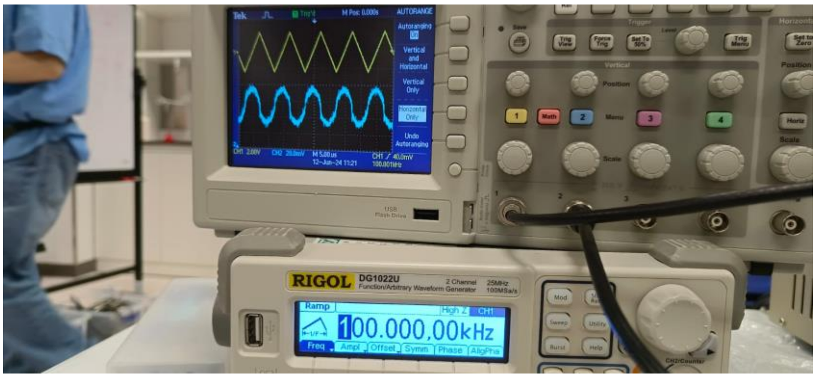


Figure 164 Waveform when frequency is 100kHz

Comment from Assessor

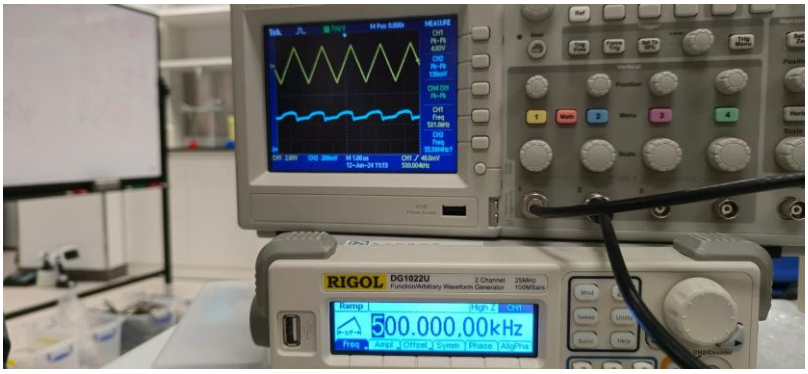


Figure 165 Waveform when frequency is 500kHz

We observed that the amplitude of the sine waveform of channel 2 decreases as the frequency increases.

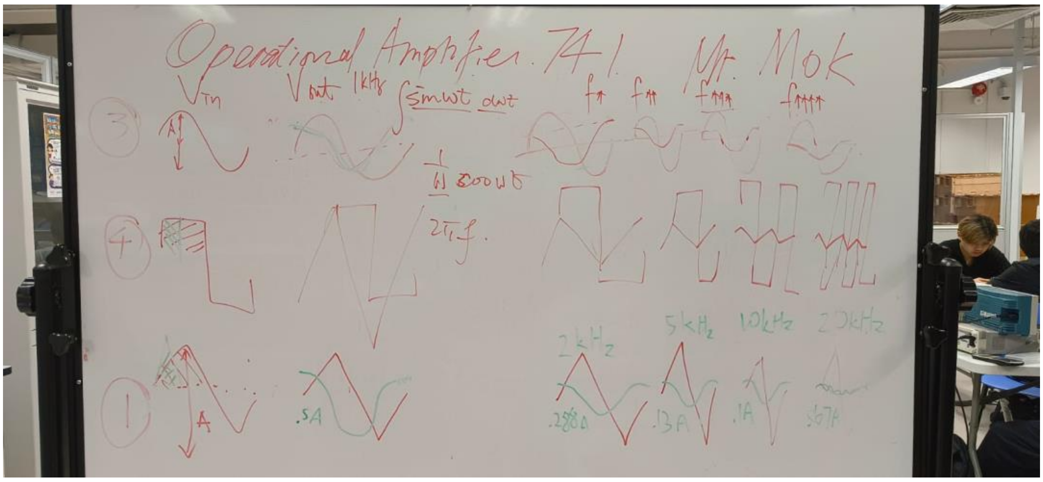


Figure 166 Comparison of difference shapes of the waveform as the frequency increases.

Comment from Assessor

Inverting differentiator

In this exercise, we connect the capacitor with the resistor in series. This connection method allows the capacitor to perform integration of the input signal which produced a integrated waveform as shown in calculation at the VOUTPUT. The resistor for earthing is changed from 22k Ohms to 24k Ohms.

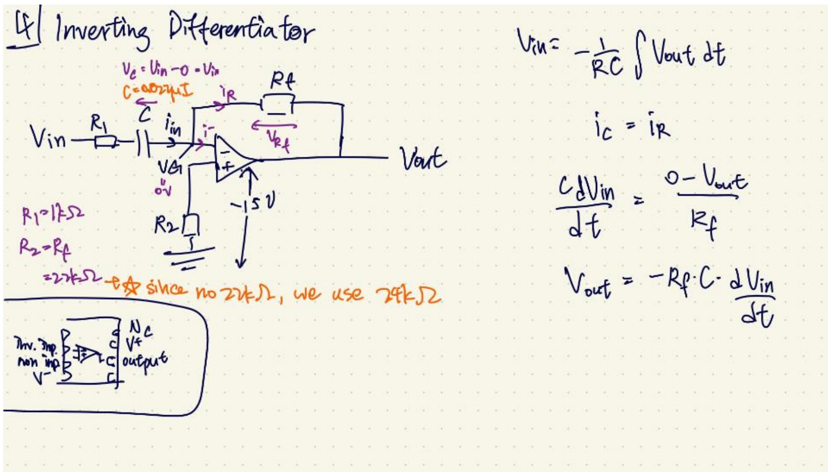


Figure 167 Circuit diagram of inverting differentiator

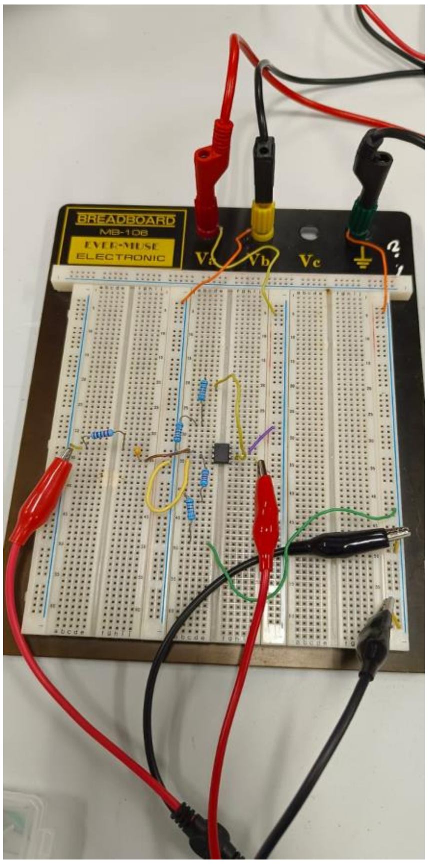


Figure 168 Circuit setup of inverting differentiator

Comment from Assessor

Figure 169 Capacitor

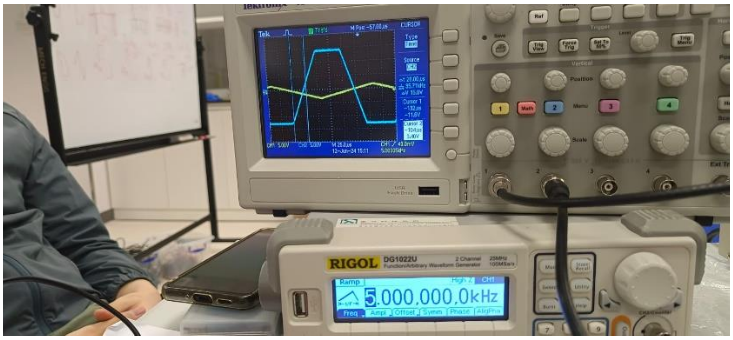


Figure 170 Waveform when frequency is 5kHz

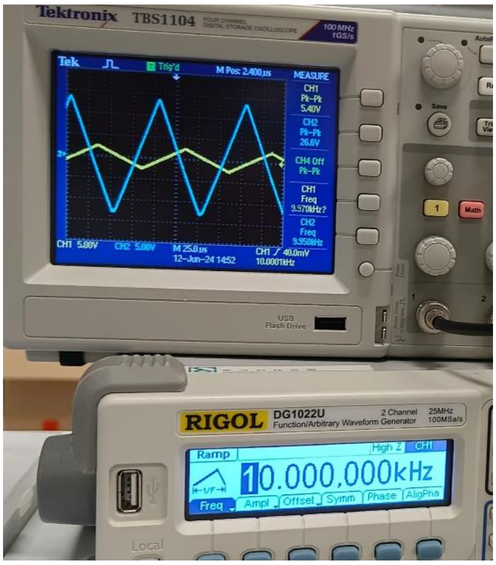


Figure 171 Waveform when frequency is 10kHz

Comment from Assessor

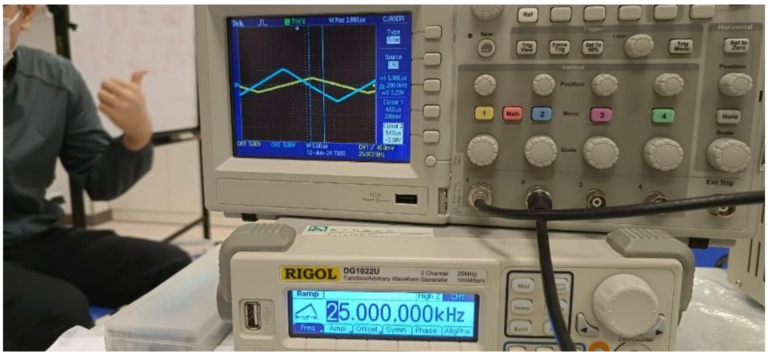


Figure 172 Waveform when frequency is 25kHz

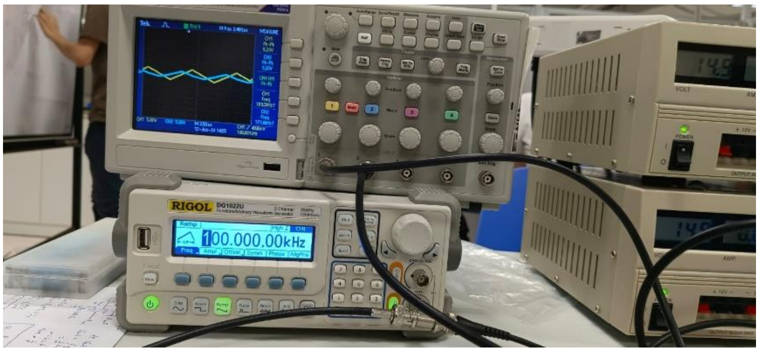


Figure 173 Waveform when frequency is 100 kHz

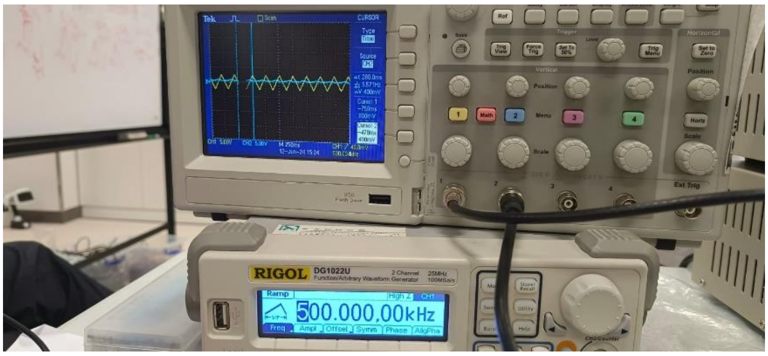


Figure 174 Waveform when frequency is 500kHz

Inverting difference amplifier

In this exercise, two VINPUT sources are connected in parallel to the circuit on the breadbroad. When all the four resistors have the same value, then VOUTPUT = -(Vin1- Vin2). The amplifier will subtract the inputs then generate the inverting output.

Comment from Assessor

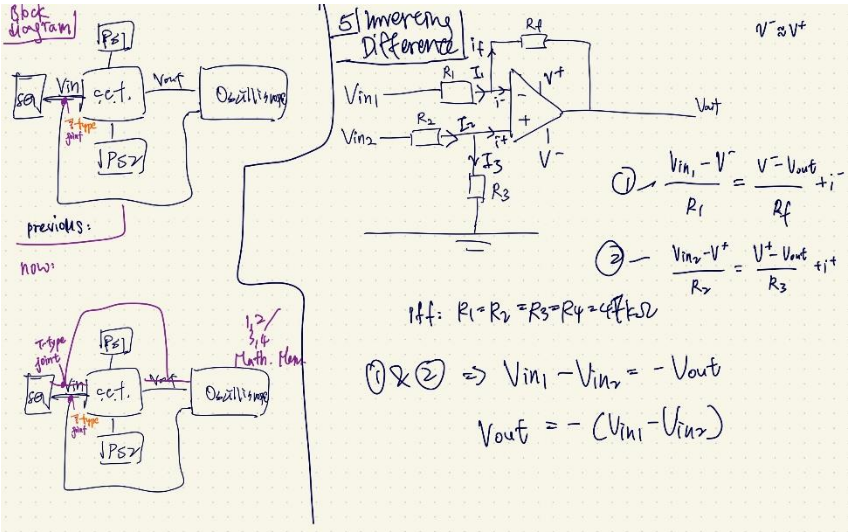


Figure 175 Notes and circuit drawing diagram of inverting difference amplifier

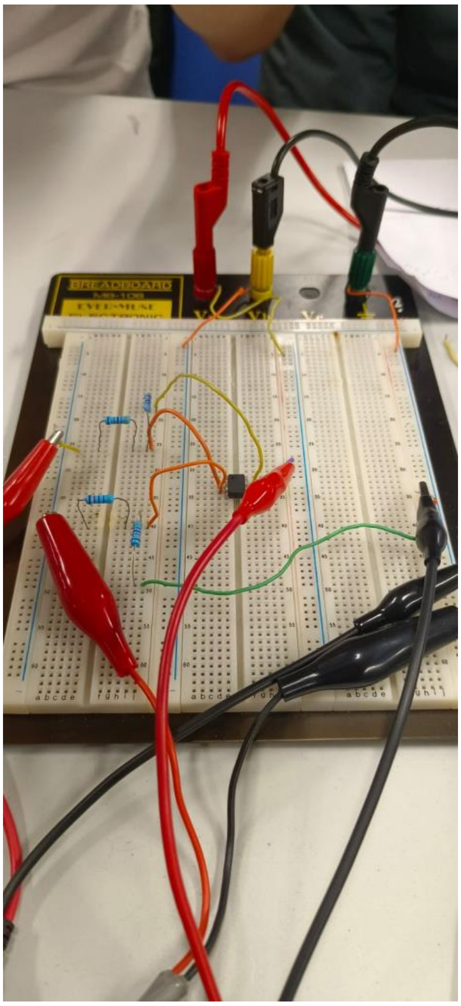


Figure 176 Circuit diagram of inverting difference amplifier

Comment from Assessor

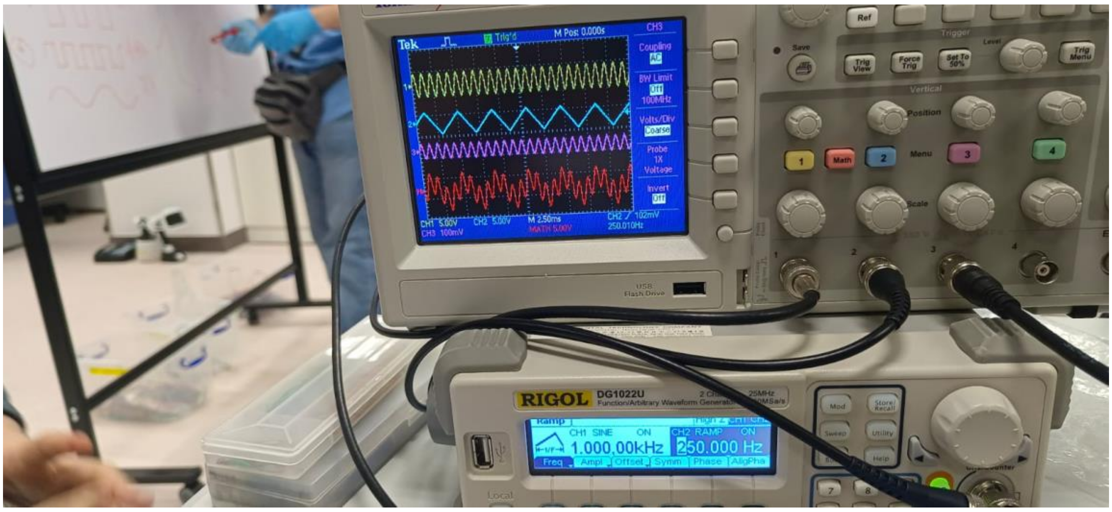


Figure 177 The resulting waveform pin red is the calculation result of the subtraction of Saw-teeth waveform and triangle waveform (channel 1 and 2).

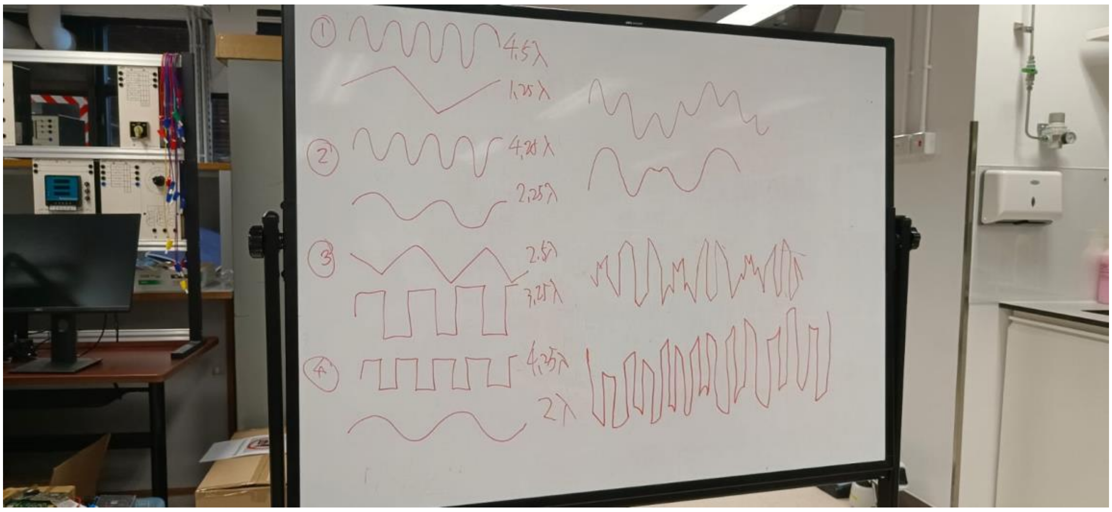


Figure 178 Drawing of the subtraction result of two different waveforms

Comment from Assessor

Training Activity on Day 3, on 13June 2024

Inverting summing amplifier

In inverting summing amplifier diagram, the voltage sources 1 and 2 are connected in the same input of the operational amplifier. It sums up the two inputs, then it generates the inverting output.

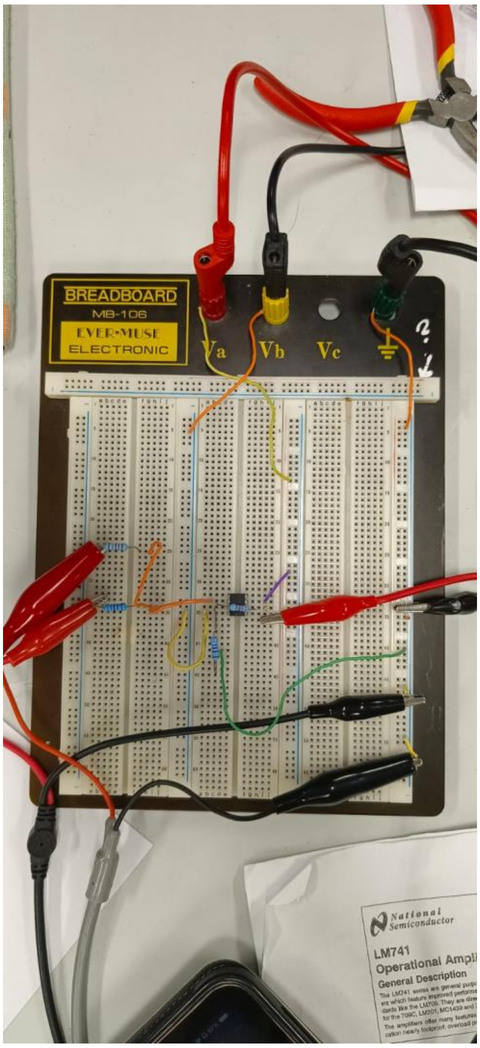


Figure 179 Circuit setup for inverting summing amplifier

Comment from Assessor

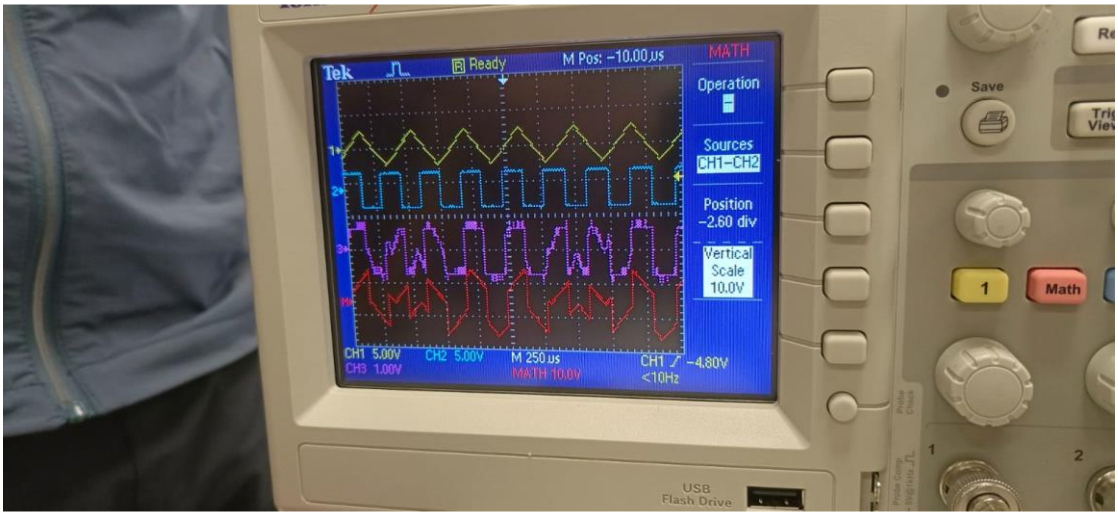


Figure 180 Summation of the square waveform of channel 2 and the triangle waveform of channel 1

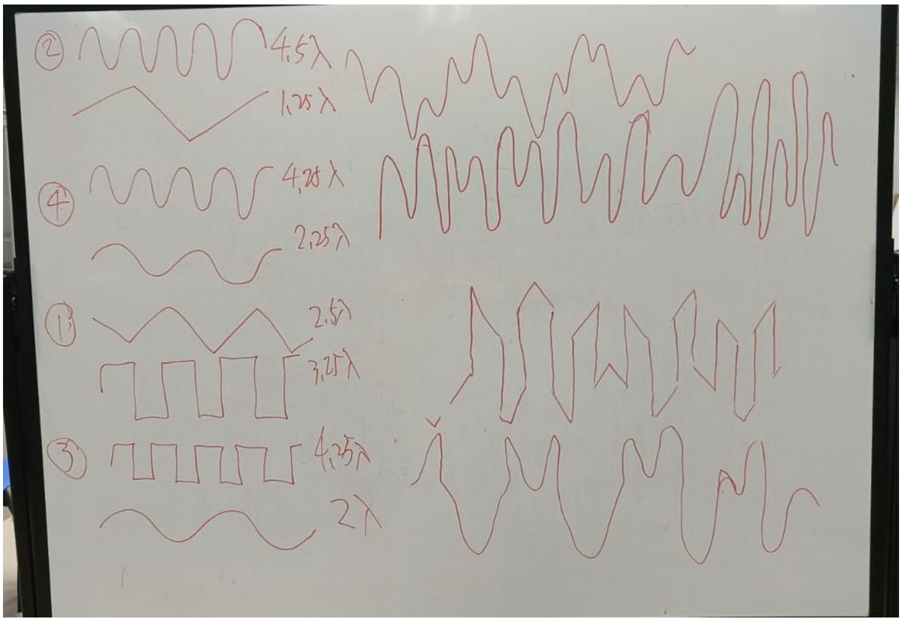


Figure 181 Drawing of summation result of two different shapes of waveforms done by each group

Restoring wires in a plug

Our next task is to retore the inner structure of a plug. A plug is an electrical device that connects to a device or component through a cord and fits into a socket. The connector pin inside the plug is made of copper to ensure good electrical conductivity. We use three-prong plug for this task. Each of them will be connected with a live, neutral and ground wires of the device respectively and connect them to the

Comment from Assessor

electrical grid and powering it on. All these wires are covered by a white sheath which acts as an additional layer to protect the inner structure from external damage.

Figure 182 The dissembled plug

To prevent an electrical device from short circuits, a fuse is inserted into an internal socket and connected to the live wire in series. If the current passing through the fuse exceeds the rated value of the fuse, the conductive wire inside the fuse will melt, cut the current and turn it into an open circuit to prevent the device from damage that can be caused by short circuit. Short circuits also occur when the live wire and neutral wire inside the device come into direct contact due to manufacturing flaws. This could generate an enormous amount of heat which cause melts the plastic cover of the device and even igniting nearby items, leading to intermediate damage.

In this exercise, we attempt to place the live wire, the neutral wire and the earth wire inside the plug, where the live wire is connected to the pin on the right and the fuse, earth wire to the pin on the left and the neutral wire to the pin in the middle. Then fix the cover of the plug.

Comment from Assessor

Figure 183 Engineering tools for restoring the plug, including electrical conduit, fliers and screwdrivers

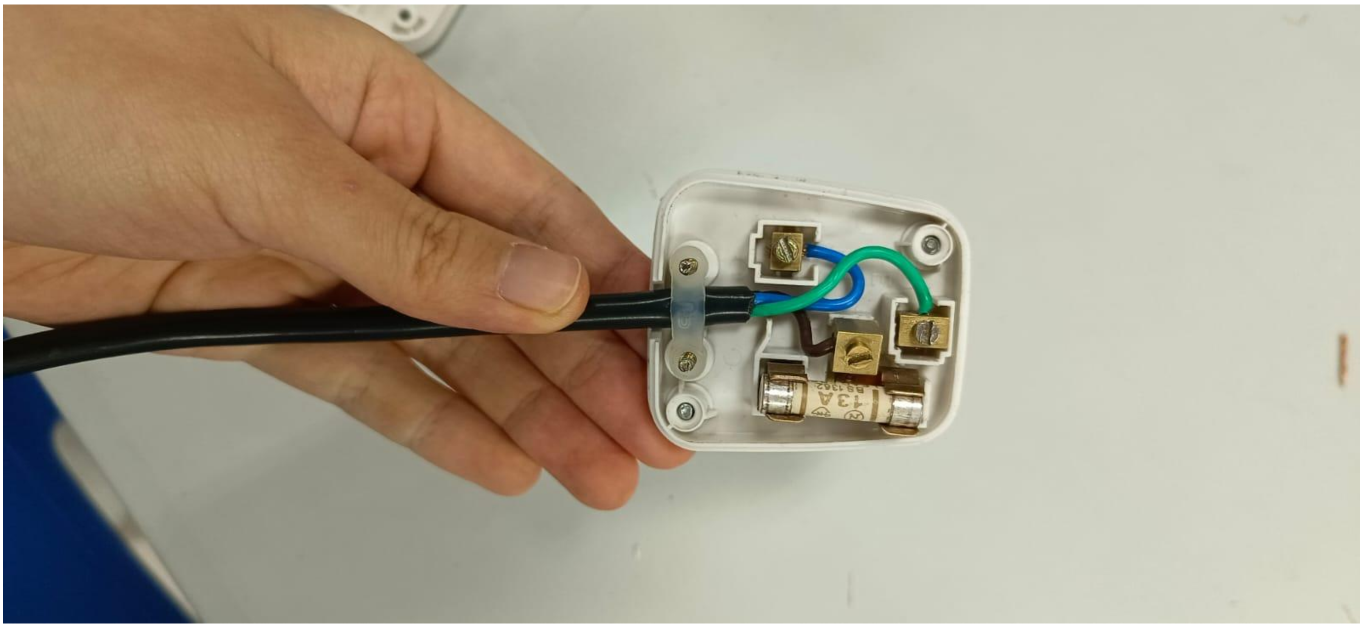


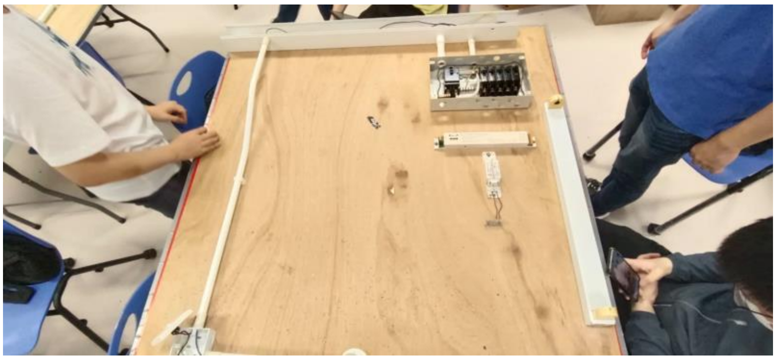
Figure 184 The repaired plug

Comment from Assessor

Training Activity on Day 4, on 14June 2024

Ring Circuit

Ring circuit is a type of closed circuit where several electrical devices are connected in a continuous loop. Ring circuit is commonly used in residential and commercial electrical systems, as it has a high flexibility by adding additional outlets to the loop without affecting the existing circuit. Also, as current can still flow through the remaining part of the circuit, if a fault occurred at a certain point in the circuit, the device can still function without disruption from the fault. Moreover, as the current in the circuit is split in half for each of the two lines in the socket, only three wires can be used. Comparing to radial circuit which has two wires connecting to every pin, in a total of six wires in the plug, ring circuit loop will be less expansive and can be installed simpler.



Comment from Assessor

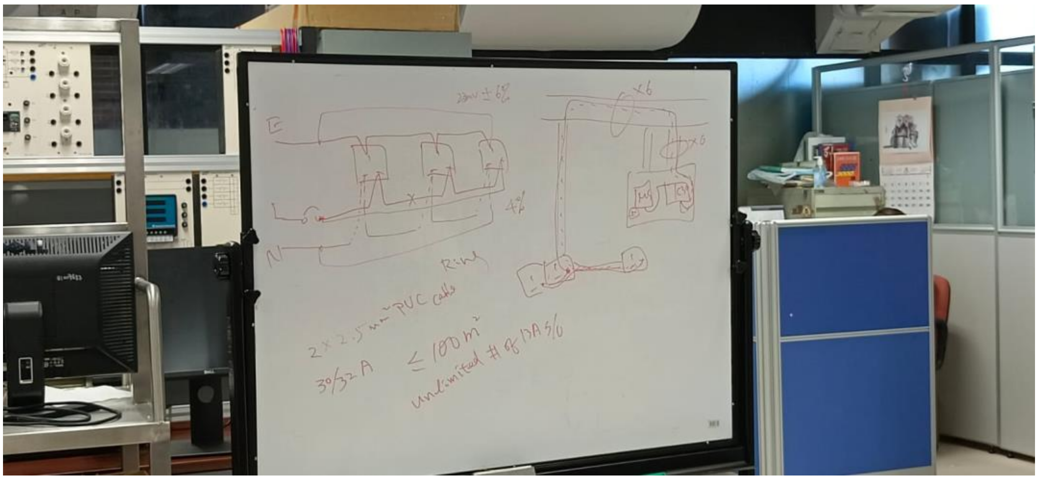


Figure 185 Rdial circuit

Study of Miniature Circuit Breaker(MCB)

A miniature circuit breaker is an automatically operated electrical switch which is used to protect low voltage electrical circuits and connected equipment from dangers of overload circuit or a short circuit. It is commonly used in residential, commercial and industrial applications and is an integral part of electrical distribution boards and panels.

Comment from Assessor

Installation of a tungsten light bulb in the circuit loop

In this exercise, we build the ring circuit loop and insert a tungsten light bulb and a switch in the circuit loop to check if circuit is correctly built and the tungsten light bulb can function normally.

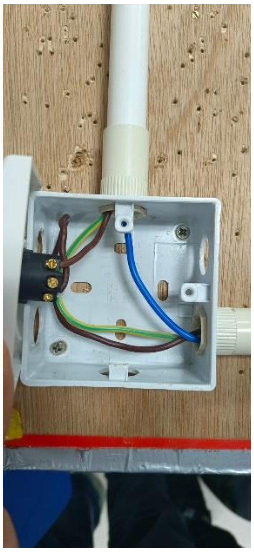


Figure 186 Control switch

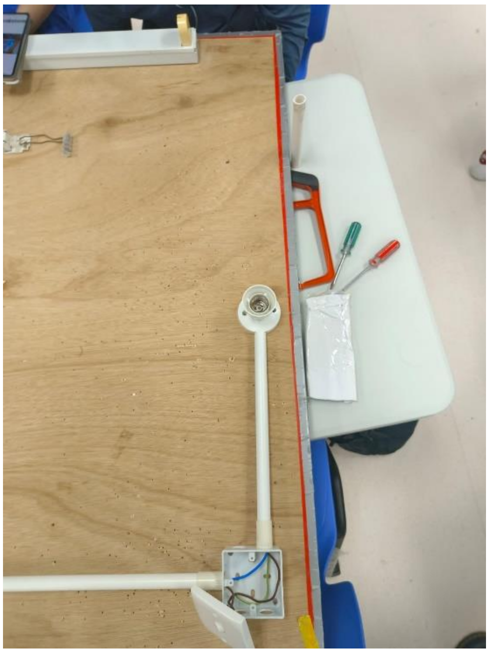


Figure 187 Installation of the tungsten light bulb

Comment from Assessor

Installation of a two-way lighting control circuit

In our second exercise, we used two NO switches to modify the circuit in previous exercise. In this circuit, the light bulb can be controlled by switching either one of the two-way single switches.

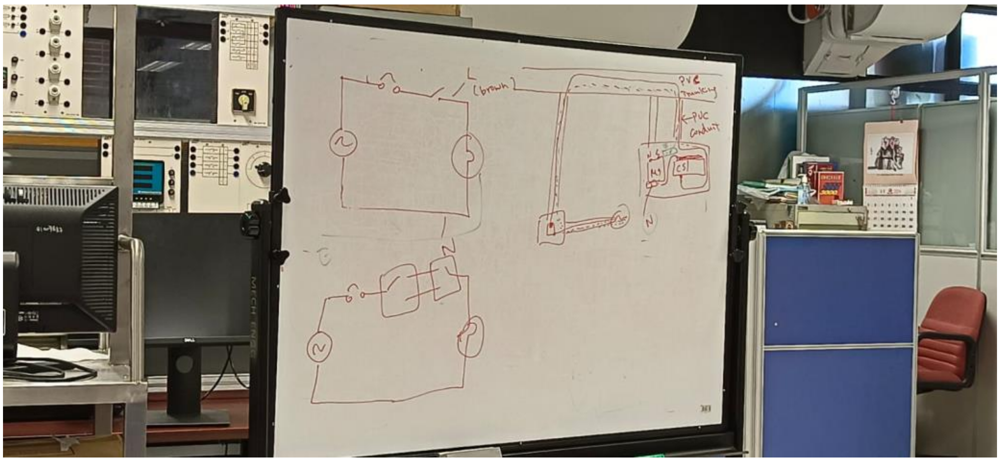


Figure 188 Circuit diagram of a two-way lighting control circuit

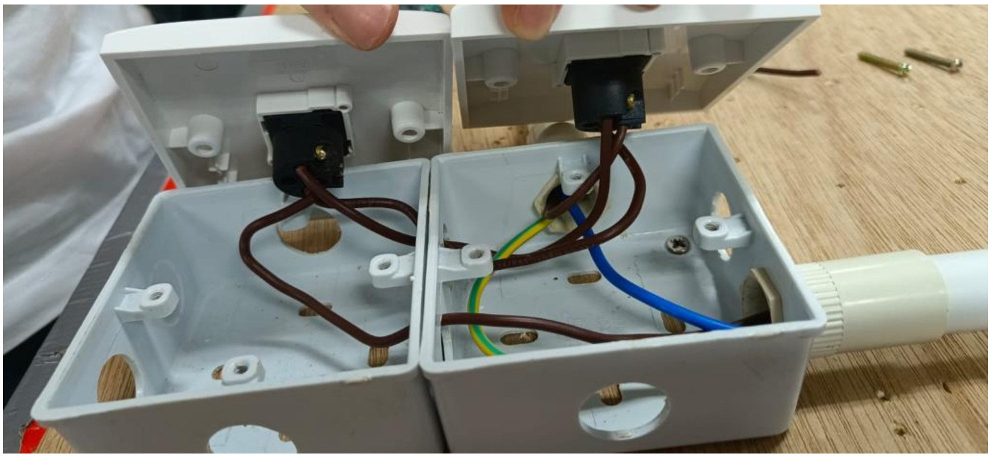


Figure 189 Inner structure of the wiring of the sockets

Figure 190 Light bulb is turned when one of the switch is pressed

Comment from Assessor

Training Activity on Day 5, on 15June 2024

Continuity test

On the final day of the EE session, we used continuity test to check if there is a smooth and complete current flow without any breaks between two points in a circuit. To do so, we first use a screw to connect the earth wire, this is for safety concern by preventing the circuit flowing through human body during the test. Then, we use multimeter to connect the live wire part of the socket and the power supply. When the switch is turned on, the value of the voltage shown on the multimeter between these two points approached zero.

Polarity test

The next test we attempted on the ring circuit is the polarity test. The purpose of the test is to ensure the correct connection of the live, earth and the neutral conductors in the circuit loop. A multimeter is used to measure the voltage and current relationships between all these three wires. In our attempt, we tried checking the connection of the live and neutral conductor.

Fluorescent light

In this last exercise, we study the operating mechanism of a fluorescent lamp. When the lamp is turned on, the ballast applies a high voltage across the two filaments of the lamp. This cause the filament to emit electrons and collide with the inert gas molecules inside the lamp. It causes the gas atoms to become ionized and create plasma. This allows current to flow through the lamp. Moreover, the plasma contains mercury vapour which is exited by the current and emits ultraviolet radiation when they undergo electron transition to their ground state. The UV radiation is absorbed by the phosphor layer coated on the inner surface of the lamp and re-emits visible light.

The use of ballast in the circuit is to regulate the current and voltage to the lamp and prevent it from overheating and burning out.

Comment from Assessor

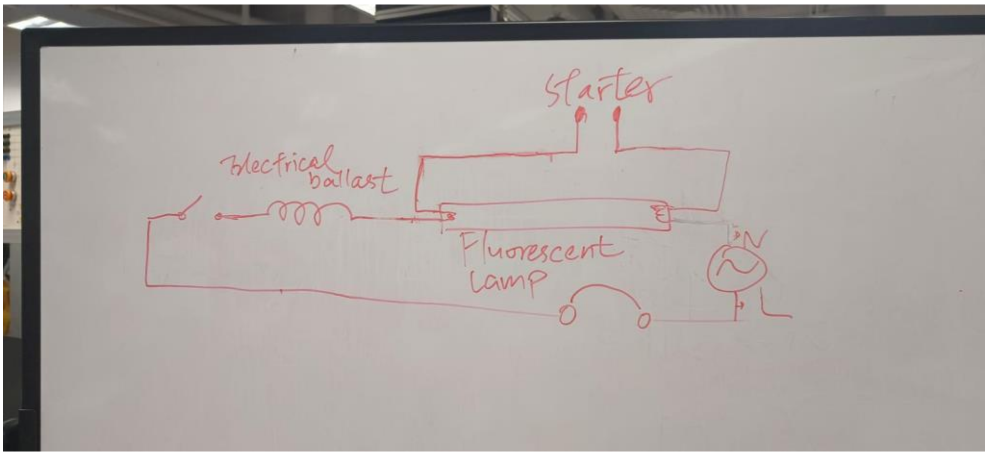


Figure 191 Circuit diagram of the fluorescent lamp

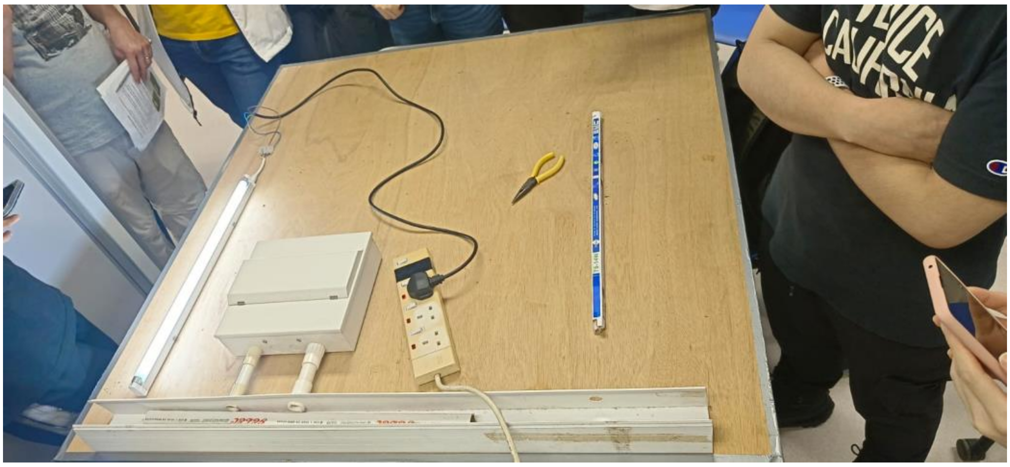


Figure 192 fluorescent lamp in first type of enclosure

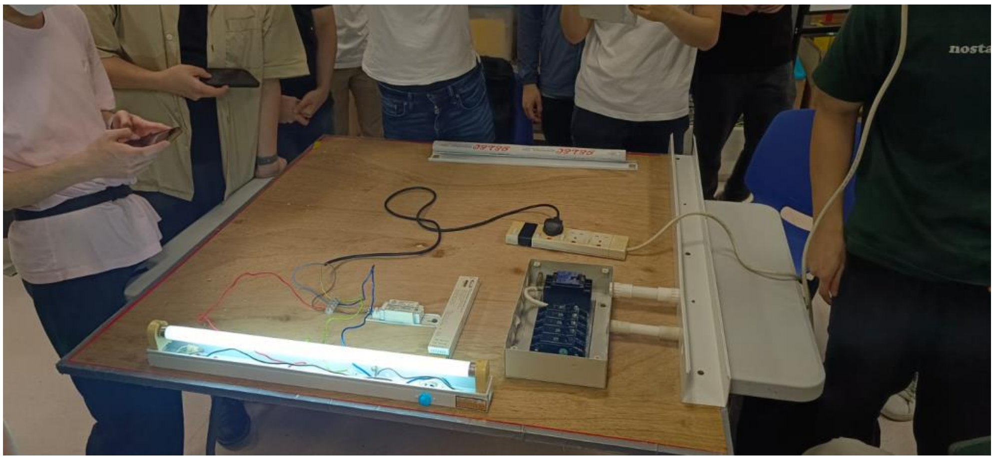


Figure 193 fluorescent lamp in second type of enclosure

Comment from Assessor

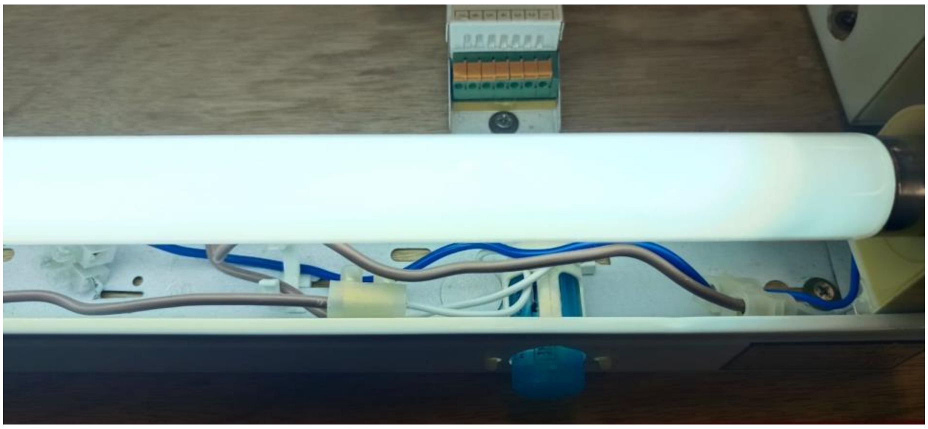


Figure 194 Inner structure of the fluorescent lamp

Comment from Assessor

Summary for Basic Electrical Engineering

Basic Electrical Engineering session provides me a very practical and interesting experience on attempting to build circuits that is mainly used in residential, commercial and industrial buildings. I have gained enormous useful knowledge about different kinds of important electronic devices, materials, circuit set up and their usage, including operational amplifier, breadboard, ring circuit, inner structure of a plug, miniature circuit breaker and tests for circuit safety and stability checking. I have a better understanding of the fundamental principles about electric circuits more clearly, and what kind of electrical part would a mechanical engineer be required to do.

I have learnt about the versatile usage of an operational amplifier in a circuit. We are required to build the circuit on our own based on an electric diagram drawn during the session by others. This trained my sense of circuit setup which helped me to gain tremendous understanding of the use of different electric components. As several types of amplification circuits have been attempted during the training session, I have a deeper understanding of the daily electrical gadgets we use and more insights on the advanced technology operating and mechanisms in our city. I have also gained experiences from practicing important procedures of the installations of some household electrical components and its circuit setup such as the use of a miniature circuit breaker, the way to cut the electrical conduit, how to insert a bouquet of copper alloy wires to the pin properly to prevent possible damage due to inappropriate design and installation of the electrical device.

Finally, we are also required to work as a team of five students to build circuits on breadboard and a typical ring circuit for household use. I have also practiced the skill of communication during the teamwork and the importance of recognizing the responsibility of a student of ensuring the working environment is safe and comfortable for colleagues. At the end of this training session, it is unquestionable that I have solved many unsureness on the structure and mechanisms of various electrical devices that are commonly used in our society, which help me to raise my confidence on solving difficulties that I may encounter in the future.

Comment from Assessor

Training Module: Machine Practice

Training Module:	Machine Practice	Student Group Attended:	ME1
Training periods	From 17June to 20June		

Training Activity on Day 1, on 17June 2024

The training venue of machine practice is in VTC in Kowloon Bay. On the first day of the machine practice training, a brief introduction about industrial safety was given by the instructor, Mr. Fong Yue Man in VTC on the first morning of the machining practice module. A powerpoint is shown and delivered to us before training begins. There are also several videos showing the serious consequences of not following the safety regulations. It is compulsory to wear the training jacket, safety goggles and safety shoes to prevent serious injuries. Mr. Fong has also talked about the emergency escape route of the building. We start our training in room 413 and I am student number 3 in team 4 with two other team members, Lo Hoi Fung, Henry and Hu Lok Hei.

The rules for Industrial Safety are as follows.

1. General
   a. Do not use any machine/tool without prior proper instruction and permission.
   b. Never run inside the workshop.
   c. Do not disturb any trainee or any other person when he/she is operating a machine tool.
2. Personal
   a. Safety glasses or goggles must be worn at all times in work area.
   b. Do not wear shoes, slippers or sandals in the workshop.
   c. Long and loose hair must be contained.
   d. No loose part in the clothes is allowed.
   e. Rings, tie, scarf and gloves must not be worn.
3. Pre-operational safety
   a. Locate and ensure you are familiar with the operation of the ON.OFF starter and Emergency-Stop of a machine tool.
   b. Make sure you know how to operate the machine before switching it on.

Comment from Assessor

   c. Machine guards must be put in position while operating.
   d. Check that the job/tool is clamped securely in the chuck/spindle.
   e. Remove all tools from the machine bed and slides of the machine after use.
   f. Ensure correct machining speed is selected.
   g. Always remove the chuck key from the chuck before starting the machine.
   h. Turn off the machine when you have finished your work, or during the setup of tools/workpiece.
4. Operational Safety
   a. Do not leave any operating machine unattended.
   b. Do not attempt to slow/stop the revolving chuck/work by hand.
   c. Never use hand file or emery cloth for finishing work on lathe.
   d. Do not setup more than one cutting tool on lathe.
   e. Do not use defective tools.
   f. Keep hands away from any rotating objects.
   g. Make sure all machines are power of before you leave.
5. Housekeeping
   a. Never carry tools in your clothing pockets.
   b. Always place tools in a secure and proper manner.
   c. Keep the machine in a safe, clean and tidy state

Vise & Jack

The first machining practice target is to get familiarise with hand tools including file, hacksaw, hammer and hand tap; marking tools, including scriber, divider, steel rule, centre punch, V-block, angle plate and surface plate; machine, including Centre Lathe and Vertical Milling Machine; and measuring instruments, including engineer’s square, vernier calipers and vernier height gauge.

Figures.

Through this practice, we learnt about the importance of following industrial safety, the operation of milling machine and Centre Lathe and other machines, making internal screw threads and workshop measurement.

Comment from Assessor

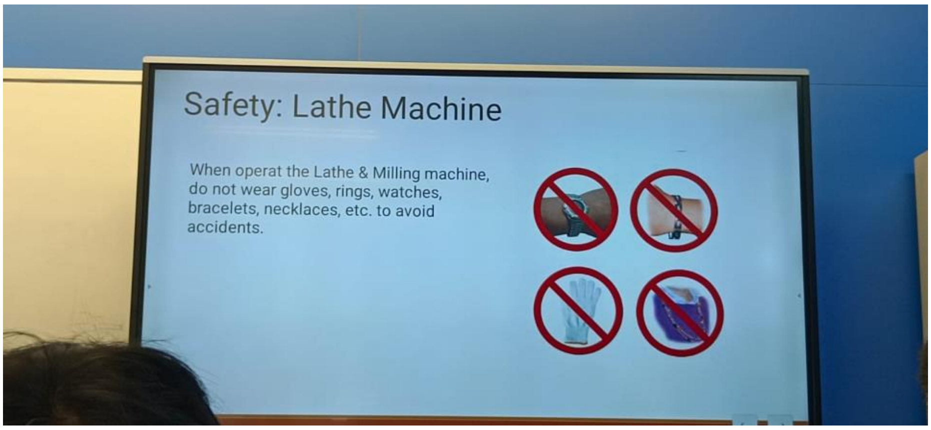


Figure 195 Briefing on safety guidelines for using different kinds of heavy machine

Figure 196 Floor plan for room 413

Comment from Assessor

Figure 197 Notes to Students on safety checking

Figure 198 Power valve should be closed when the machine is not in used

Figure 199 the lathe and milling machine we use for first three days.

Comment from Assessor

Figure 200 These handles controls the rotating speed of the lathe machine

Figure 201 By loosening the screw, we can change the orientation of the block

Figure 202 This rotating handle manages the position of the block

Comment from Assessor

Figure 203 Tools

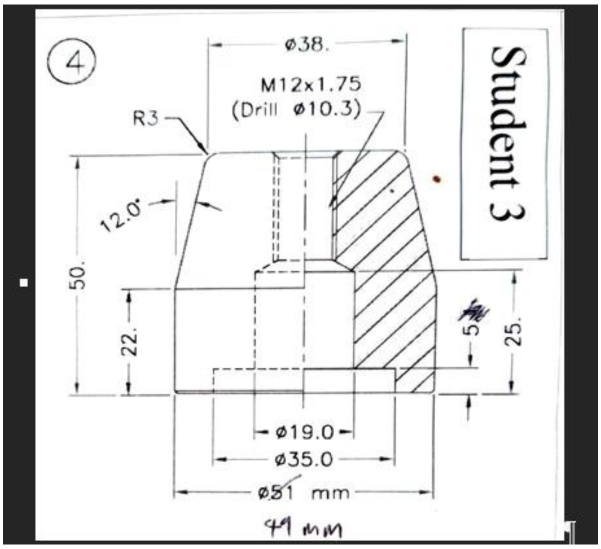


Figure 204 My task in the first exercise

Facing

Our first task is to slice the surface of the cylinder solid until it looks shiny and smooth.

Figure 205 Measuring the position of the knife

Comment from Assessor

Figure 206 the cylinder solid surface before it is sliced

Figure 207 shows the cylinder solid surface after it is sliced

Drilling

First, a Ø8.0 center drill is used to make a start, then we use Ø10.3 center drill to make drilling. After drilling, we added chamfer at the edge at 0.5mm.

Comment from Assessor

It is really important to be patient during the drilling process. The drill may break and stuck in the metal piece and takes some time to get it out.

Figure 208 Center drill begins to drill the workpiece.

Figure 209 drilling the workpiece

Comment from Assessor

Figure 210 The broken drill stuck in the workpiece.

Tapper turning

Next, we sliced the body of the cylinder to make a slant circular plane. Set the top slide to 12° and do tapper turning. The length that needs to be sliced is 28mm.

Figure 211 Tapping using primary, secondary and third tap wrench

Comment from Assessor

Use R cutter to form the outer corner

Figure 212 R cutter

Figure 213 We use R cutter to form outer corner

Comment from Assessor

Training Activity on Day 2, on 18June 2024

Cutting off the shaft

Use parting tools to cut off the shaft. Change the speed of the lath machine into 300rpm, then use the double stepping method to cut the shaft off. Measure the distance from the head of the metal piece to be 80mm, then after the shaft is entirely cut off, we use facing method to make the face to become shiny and slice it back to the required 50mm length. Set the speed of the lathe machine at 300rpm, double step down to part the shaft off.

Figure 214 The length of the cylinder surface should be 22mm. It can be corrected by using facing method.

Figure 215 Parting tools

Comment from Assessor

Dilling

Drill Ø1/2” at 300rpm, Ø5/8” and Ø3/4” at 200rpm to 25mm depth.

Figure 216 Drilling

Countersink

Figure 217 Countersink

Boring

Boring at 400rpm to Ø35 x 5.1mm. After that, chamfer the edges at 0.5mm and drill again.

Figure 218 Difference between a birmal drilling tool and the M12x1.75 drilling tool.

Comment from Assessor

Figure 219 Chamfer tool

Figure 220 Chamfer the edges at 0.5mm, and drill again

Tapping

Turn off the power and use first tap, second tap and the bottom tap respectively to tap M12 x 1.75.

When using the first tap, hold in wrench and apply downward pressure. Then rotate the tap until the cutting starts, make sure it is tapping perpendicular to the workpiece, oils needed to be added to avoid breaking the tap. When the head of the first tap is drilled into the hole, no further pressure and oil is required to apply on the tap as it will screw through the hole smoothly by itself. During the tapping process, the tap should be turned back often to help clear chips from the flute. If not, the tap would be broken as it cannot overcome the friction force between the tap and the wall of the hole.

Cleaning and finishing the body shaft

After finished making the shaft, we need to remove the oil stains and excessive iron fillings on the machine, the ground and the shaft. Make sure the power is turned off.

Comment from Assessor

Assemble the Jack

Assemble all the metal components with other groupmates to form the Jack.

Figure 221 The workpiece of my part

Figure 222 The assembly of all three parts. There was a problem with the tapping process, so the screw does not fit into the body shaft

Comment from Assessor

Training Activity on Day 3, on 19June 2024

On the third day, we make the Vise using a vertical milling machine. The instructors of this sessions are Mr. YM Fong and Mr. KC Tse, and the training room is in room 413. The group division arrangement is the same for that in Jack making process.

Figure 223 Milling machine

Sliding Jaw: Drilling

The first metal piece I am making is the sliding jaw. First, we need to do facing at the corner and drill the Ø8mm through hole, then drill Ø9.5mm through the hole.

Figure 224 Ø9.5mm screw

Comment from Assessor

Figure 225 Facing the workpiece to get a desired size of the piece

To do this, we used a center drill to dig a shallow hole first, so it's easier for larger drill to drill the metal piece without breaking the drill.

Figure 226 This handle is for controlling the position of the drill.

Comment from Assessor

Figure 227 Digging the hole in the workpiece.

Countersink

Next, make a countersink at the edge of the hole.

Figure 228 The first half part of the workpiece is done. Countersink is later made at the edge of the hole.

Comment from Assessor

Training Activity on Day 4, on 20June 2024

On the fourth day, we continue making the Vise components.

Drilling

Use two circular rods to measure the centre of the hole on the block. First by touching the two rods edge and set it as X axis: 0.000, then we can determine the centre point of the hole.

Figure 229 Measuring the position of hole to be dug

Figure 230 Electric display for showing the position of the table in x and y axis.

Comment from Assessor

Figure 231 Center drill for diggin a shallow hole on the workpiece

Next, we use a Ø 8.5mm drill to dig a hole that is perpendicular to the previous Ø 9.5mm hole.

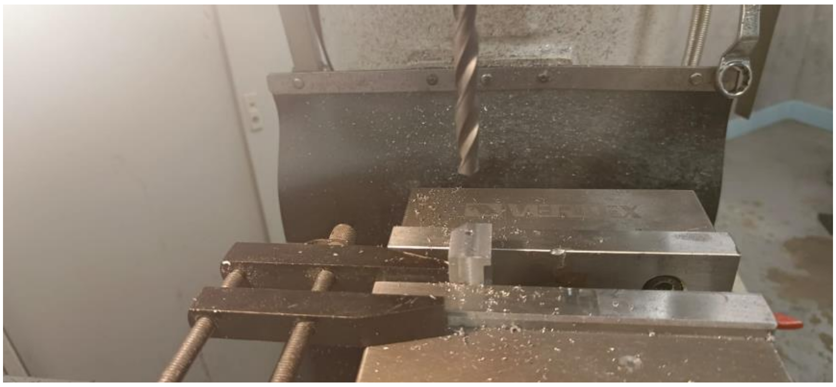


Figure 232 Drilling

Comment from Assessor

<table>
<tr>
<td>
Figure 233 This handle is to control the vertical position of the drill</td>
<td>
Figure 234 Drilled hole on the workpiece</td>
</tr>
<tr>
<td>Countersink

Figure 235 Make countersink at the edge of the hole</td>
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Comment from Assessor

Drilling the inserts

Drill the inserts from raw materials and then cut to length.

Figure 236 For measuring the vertical position of the hole on the rod

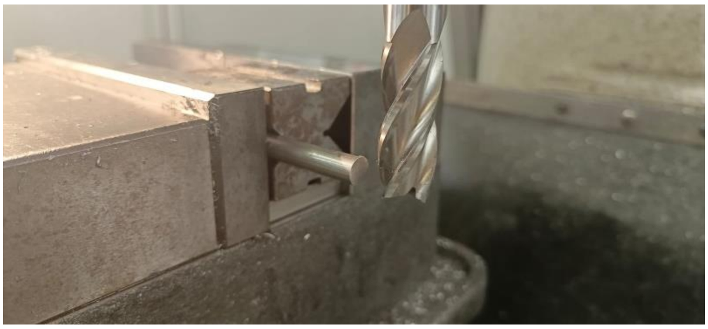

Figure 237 For measuring the horizontal position of the hole on the rod

Tapping

Figure 238 Tap M4 threads with first tap, second tap and bottom tap.

Comment from Assessor

Assembly and testing

Figure 239 The finished workpiece

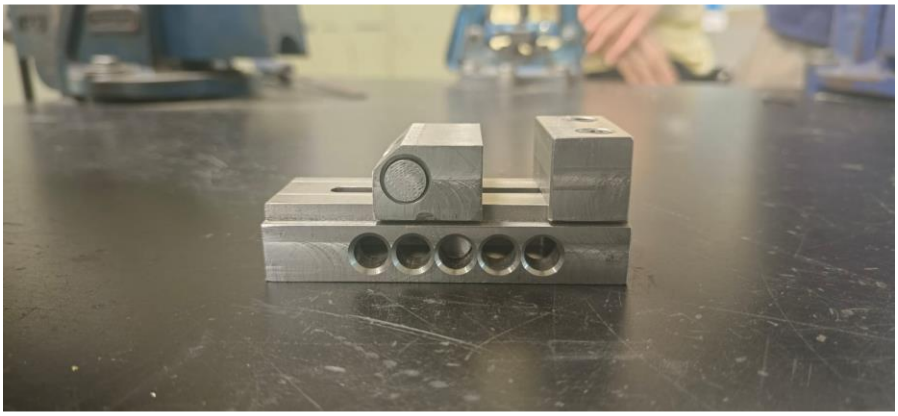

Figure 240 Assembly of all the components

Figure 241o Demonstration of the use of the Jack

Comment from Assessor

Training Activity on Day 5, on 21June 2024

On the fifth day, we get familiar with the operation of surface grinding machine. A surface grinding machine is a type of grinding machine used to produce a smooth, flat surface on a workpiece. It is a commonly used tool in various manufacturing and metalworking industries. It is also used to produce high-precision, flat surfaces on a wide range of materials, such as metal and ceramics. A typical surface grinder uses a diameter of 180mm with 20mm width to diameter of 300mm with 25mm width grinding wheel driving at 3000rpm. The reciprocating table and cross-slide movements are hydraulically operated. There is an alternative hand operation provided.

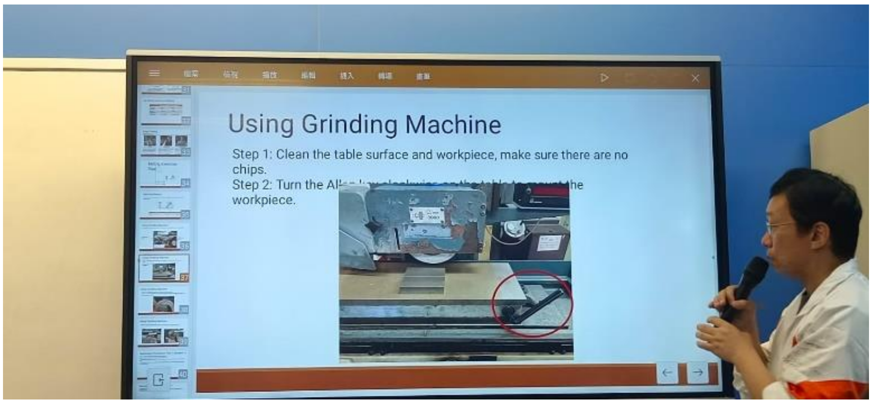

Figure 242 Introduction on the use of grinding machine

A surface grinding machine includes several components:

- Base: It is a heavily ribbed box-section casting to ensure rigidity and complete freedom from vibration.
- Column: It is guided on a dovetail slide, carries the wheelhead at its top end and contains the motor and belt drive to the wheel spindle.
- Wheelhead: It carries the wheel spindle, which is mounted in precision bearings.
- Saddle: It fitted on top of the base in the two vee slideways and provides cross-traverse movement. The cross traverse can be applied automatically in continuous or incremental feed by hydraulic power or, alternatively, with a manually operated handwheel.
- Table: It is guided by the vee-and-flat slideway on the saddle and can be manually operated with a handwheel. Automatic reciprocation of the table is transmitted through a hydraulic cylinder at infinitely variable speeds from 0.6 to 30m/min.

Comment from Assessor

Figure 243 Grinding machine

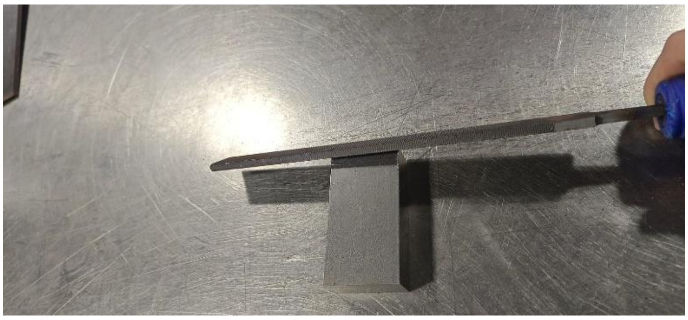

Figure 244 Use file to smoothen the edge of the metal piece to make sure my hand will not be cut by the sharp edge.

Figure 245 Grinder

Comment from Assessor

Figure 246 There is a magnet inside the table, so the metal piece will be stabled on the table. A layer of the stone may be peeled off during grinding.

Figure 247 Buttons for turning on and off the machine and the air remover

Figure 248 The grinding process. The plastic cover must be placed in front of the machine so it can block the metal debris and protect user's eye and body.

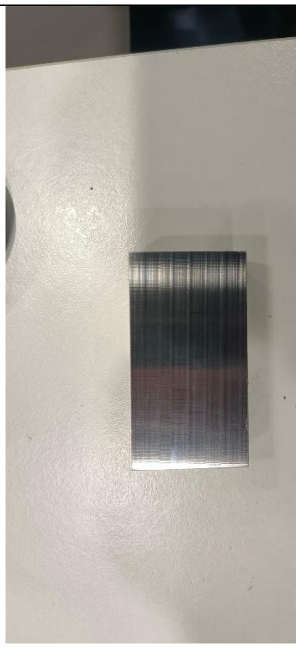

Figure 249 The grinded metal piece with a smooth and shiny surface

Comment from Assessor

Summary for Machine Practice and Workbench Practice

At the beginning of this Machining Practice module, our instructor gave us clear instructions and a detailed briefing of industrial safety. It is important to acknowledge that safety comes first in a workshop where different kinds of tools and machinery are used. A powerpoint is shared with us about safety precautions we should follow throughout the training, including wearing personal protective equipment (PPE), following standard operating procedures (SOPs), and keeping the workplace clean and organized. We are able to create a safe and productive work environment for everyone throughout the training session. Therefore, safety is the priority over all other issues.

Throughout the training session, I was able to gain detailed understanding and substantial knowledge and hands-on experiences in the operation of heavy machinery, including the lathe machine, milling machine and surface grinding machine. During the first part of the session, we needed to make Vise and Jack. There were several steps that required drilling. We should pay attention that the force of pushing the drill into the metal piece should be slowly applied throughout the time. Otherwise, the drill might break into half and stuck inside the metal piece, which took a lot of time to take out. It was also a memorable experience for me which made me reflect on my attitude that I should be more patient and careful when following the procedures.

Moreover, when we used the lathe machine and milled the metal piece, it is crucial to follow the steps indicated in the notes or by the instructors, such as adding oils throughout milling and drilling so the drill and the metal piece would not break due to strong frictional force producing between the wall of the metal piece and the drill.

During the second part of the session, we made the slicing jaw and the inserts of the vice. It is very important to make sure the plastic cover blocked the metal crumbs' flying direction as the student beside me and I got hit by some of the flying pieces, luckily, we did not get hurt or left any scars on our skin. During the tapping process, always remember that the turning direction should be in anti-clockwise. I was not able to press the tap into the hole of the metal piece as the turning direction was wrong. This again reminded me that following safety precautions and the procedures properly is crucial.

Comment from Assessor

After finishing the making process, we assembled all the components to form the Jack. However, we found that the hexagonal head screw could not fit into the body shaft. There were mistakes made when making the threaded screw as the applied force when making the threads is not equal. As a result, we could not assemble all of them properly.

In the workbench practice session, we were required to make a metal box. From the experience of performing simple benchwork tasks of metal production, I get familiar with the use of various hands-on tools like hand saw, hammer, half round file scraper, and power tools like drill press and machineries such as folding machines used in the workbench practice. I am able to use measuring tools such as vernier calipers, protractor and height gauge proficiently to improve the accuracy of my benchwork tasks. Throughout the whole working process when making the metal box, a careful awareness on the sharpness of the metal pieces is acquired.

Overall, I have a better understanding of manufacturing field and grasped the beauty and art of the product making process in this machining training and workbench training. It also gave me a solid base in understanding and operation of the process manufacturing parts. I am confident in applying these skills in real-life situations and related industries and I look forward in consistently developing my engineering skills and expertise in this field.

Comment from Assessor

Training Module: CAD/CAM

Training Module:	CAD/CAM	Student Group Attended:	ME1
Training periods	From 24June to 28June		

Training Activity on Day 1, on 24June 2024

Include the figure of the prototype, also include the 3D drawing

3rd task: kinematic design, motion design for machine, have to include kinematic analysis here, must include cutter path, all pictures should be captured on screen instead of phone, showing id, subgroup id, don't extract everything from the notes

In this week of CAD/CAM session, our objective of this exercise is to familiarize the use of FEA analysis, kinematic analysis using CADCAM software and cutter path generation for CNC machine. Then, we learn to use Autocad for structure drawing, practice clay modelling and get familiarize with the machines and devices in G14 room.

On our first day of CAD/CAM training session, we used Solidworks to design a L shape beam to examine the payload to weight load ratio by using FEA tools.

Finite element analysis (FEA) is a process of examining an object's behaviour before it is manufactured based on calculations made with the finite element method (FEM) which is a mathematical technique. It predicts several physics effects of a product which reacts to real-world forces, including vibration, heat, and fluid flow.

Before designing our own beam, we attempted all the exercises to get familiarize with the use of FEA analysis.

Comment from Assessor

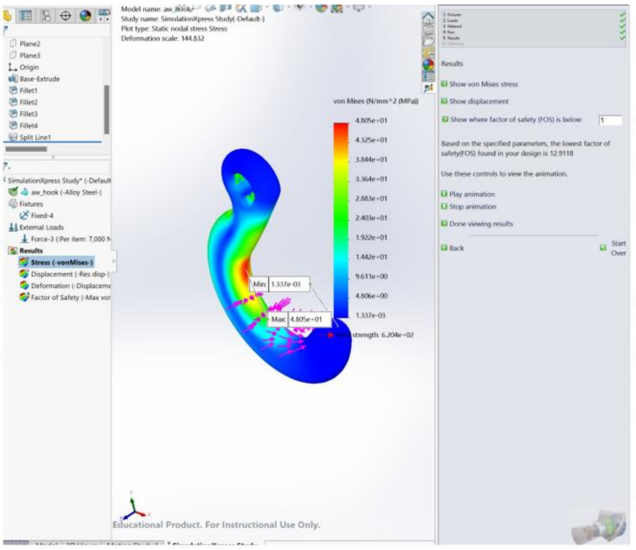

Figure 250 This is the diagram showing the stress (-vonMises) analysis.

Practice: Static analysis of a bracket

In this exercise, we learnt to set meshing options, viewing basic results of static analysis, assessing the safety of the design and generating a study report.

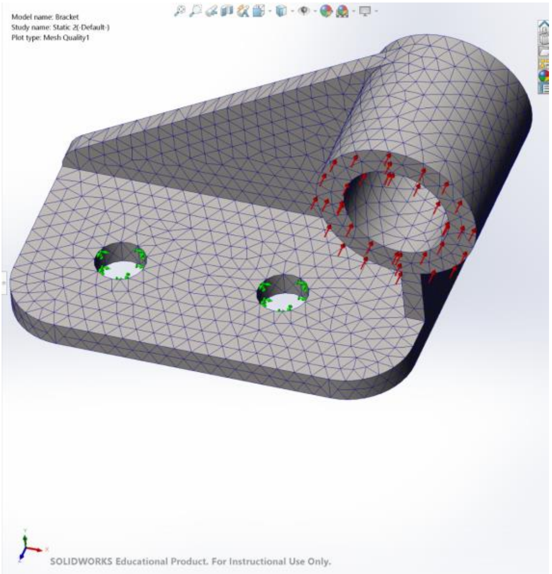

Figure 251 This is the second exercise. The figure shows the mesh quality of the object.

Comment from Assessor

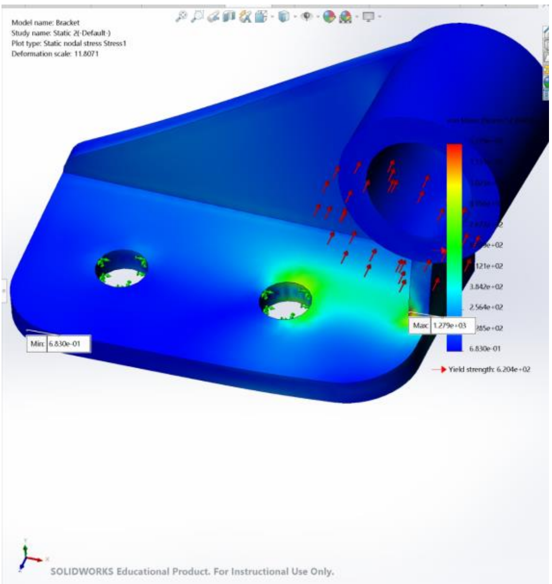

Figure 252 shows the diagram of the stress analysis of the object. For this kind of ductile material, we use Max Von Mises Stress criterion for stress analysis.

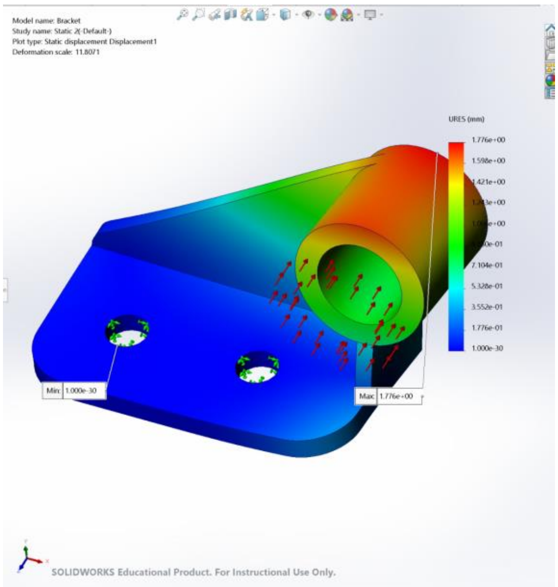

Figure 253 is the displacement diagram of the object. The circular cone part in red colour experienced a larger distorted displacement in blue colour.

Comment from Assessor

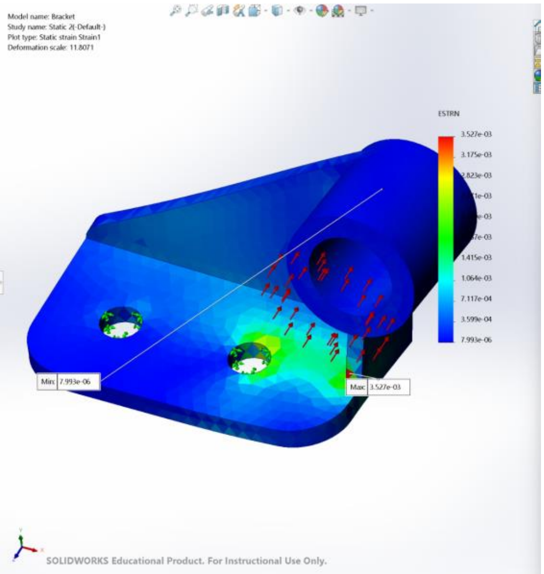

Figure 254 is the diagram of the strain analysis of the object. On the scale shown on the right, it shows that region in green colour experienced a larger strain force than the region in blue colour.

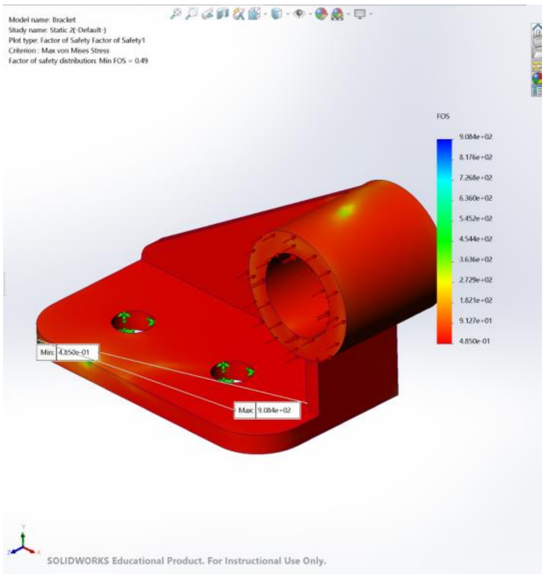

Figure 255 is the diagram of the Factor of Safety analysis of the object. When the FOS value of the object is less than 1, it is shown in red which means that part is an unsafe region. If it is in blue, that part is a safe region. The diagram shows that the mater.

Comment from Assessor

Practice: Static analysis of an assembly table

Figure 256 table assembly

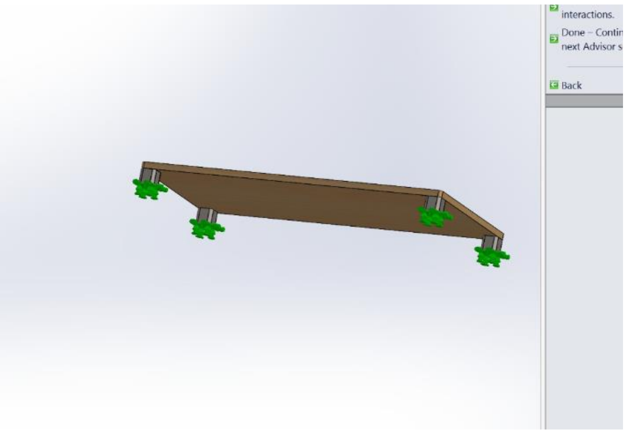

Figure 257 adding fixture to the four faces of the table legs

Comment from Assessor

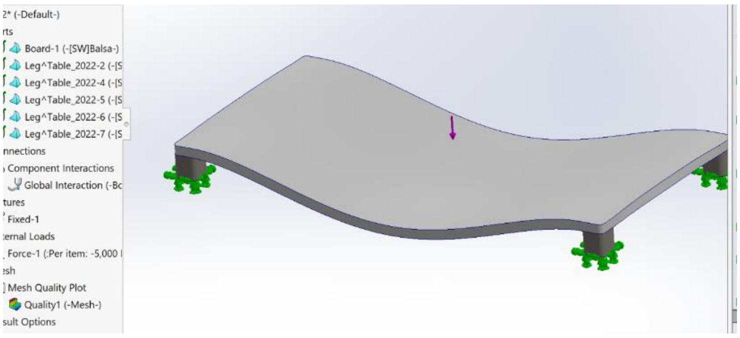

Figure 258 shows the distorted assembly after an external force of 5000N is added vertically onto the center of the top face of the table, indicated as the purple arrow. The material of the table is changed from Maple to Balsa to avoid the problem of applying load

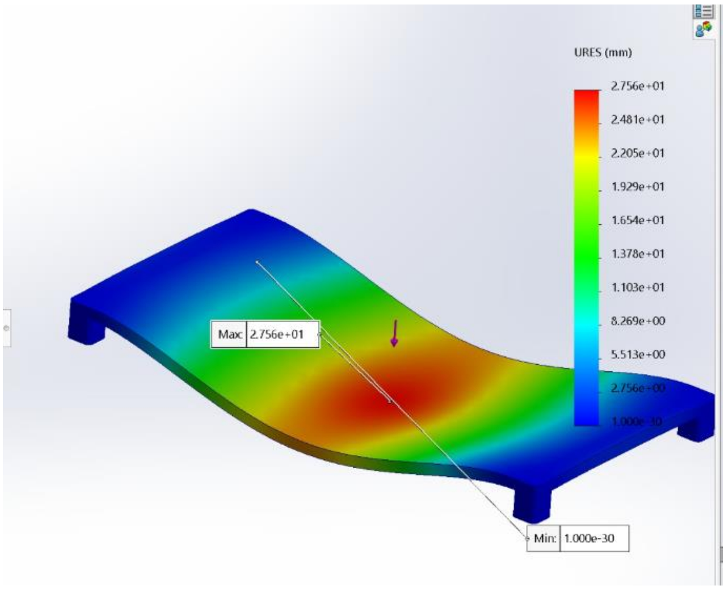

Figure 259 shows the displacement analysis of the table. From the scale shown on the right, the red region indicates the displacement due to the applied load is really high, while blue region indicates the displacement is very low.

Comment from Assessor

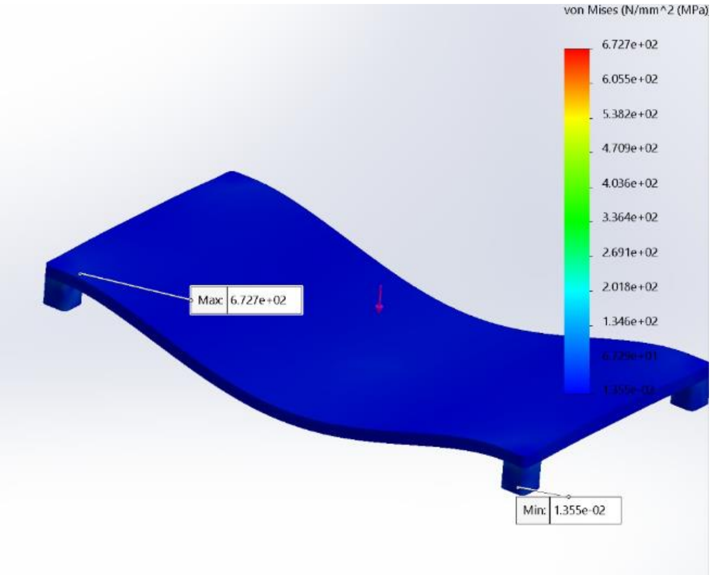

Figure 260 shows the stress analysis on the whole table.

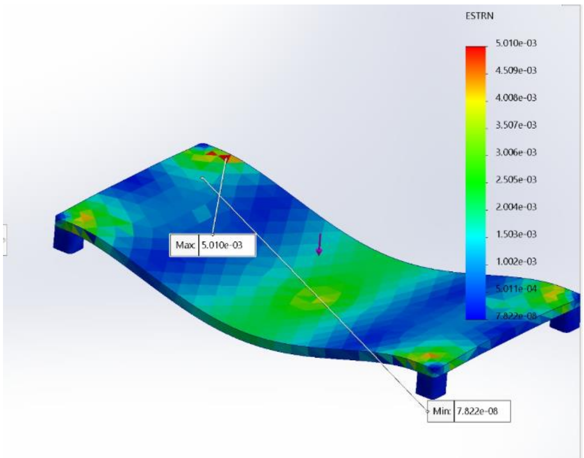

Figure 261 shows the stress analysis of the table after the external load is applied.

Comment from Assessor

Static Analysis of a beam

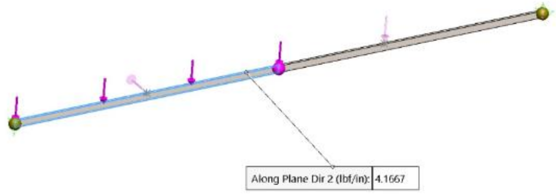

Figure 262 shows the distributed load per unit length on the beam

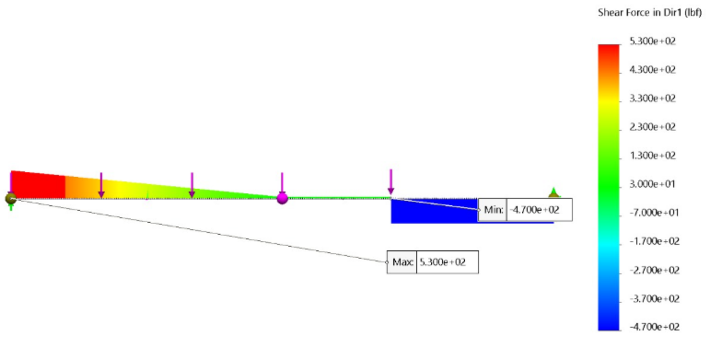

Figure 263 shows the shear force diagram of the beam

Comment from Assessor

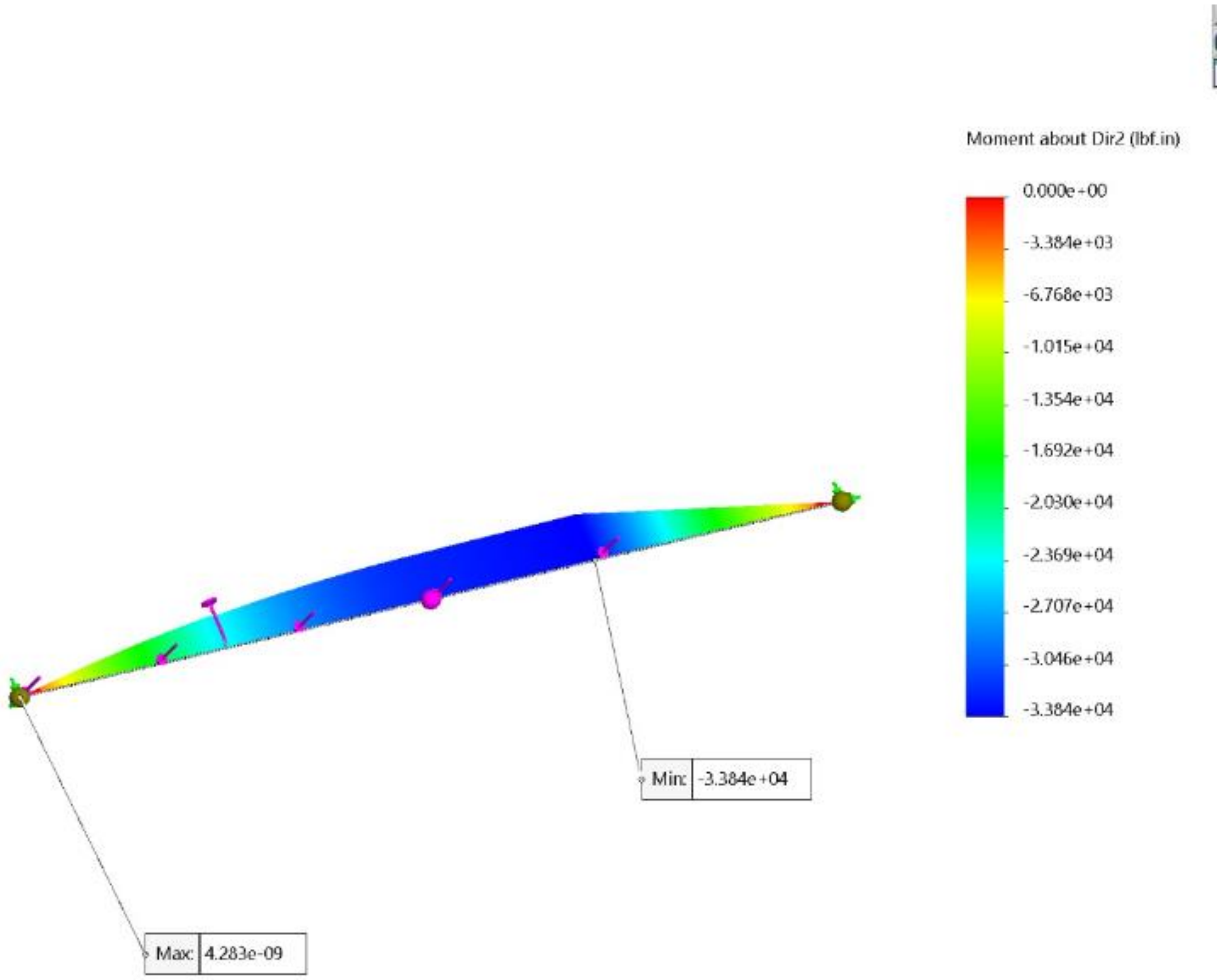

Figure 264

L beam design

To reduce the weight load of the beam, I designed square shape holes on my beam, and left more spaces at the edge part of the beam so it can withstand a large force. Moreover, we have learnt how to change the material, measuring the mass properties and doing CAM simulations in Solidworks. Through using simulation we are able to do FEA analysis before we make the product through 3D printing.

Comment from Assessor

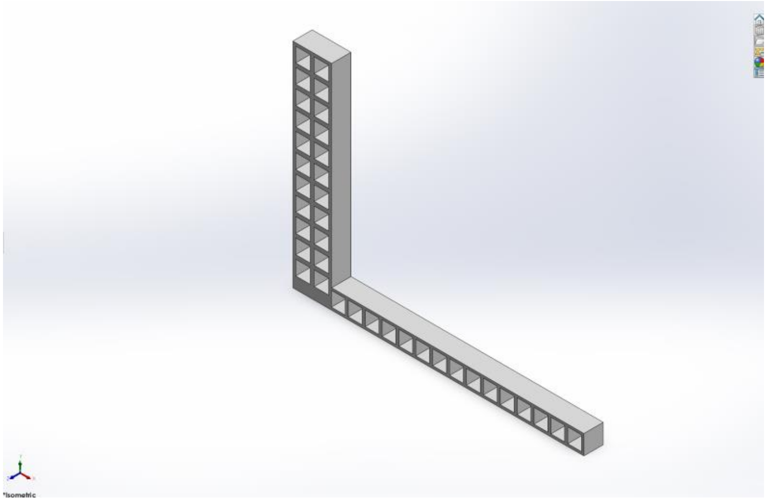

Figure 265 of the design of L shape beam

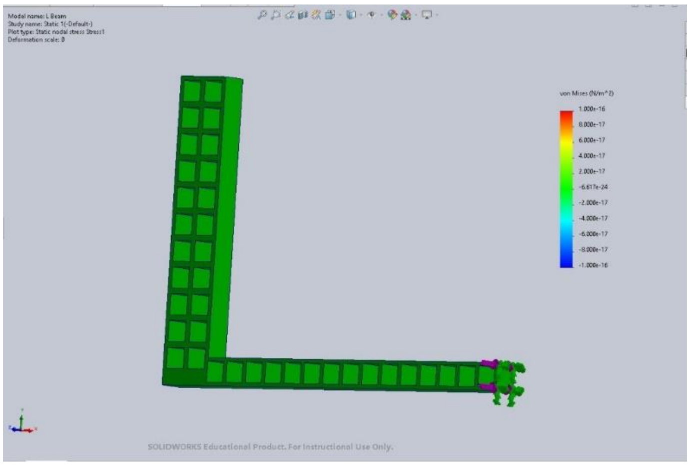

Figure 266 shows the result of stress simulation on this L beam.

The green colour on the beam shows that the whole body of L beam experiences an equal stress.

Apart from the L beam, we have also done practices for getting familiarise with kinematic analysis. The two exercises we did is cam and valve and moving along the path. Then, we designed a simple 4 bar linage system, and we performed kinematic analysis to track the motion of the linkages.

Kinematic analysis can be used to describe motion of objects without reference to the causes of motion, such as forces. It uses kinematic quantities to do such analysis, such as the trajectories of points, lines and their differential properties. Before designing the linkage, we attempted all the exercises for us to get familiarised with the use of kinematic analysis.

Comment from Assessor

Cam and valve assembly

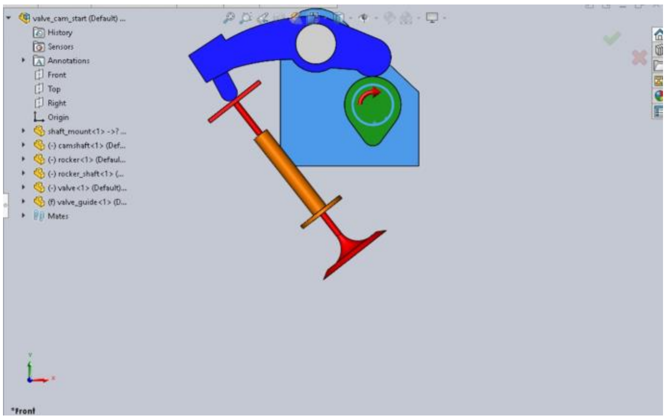

Figure 267 of the cam and valve assembly.

I have added a rotary motor to the edge of the camshaft for motion analysis.

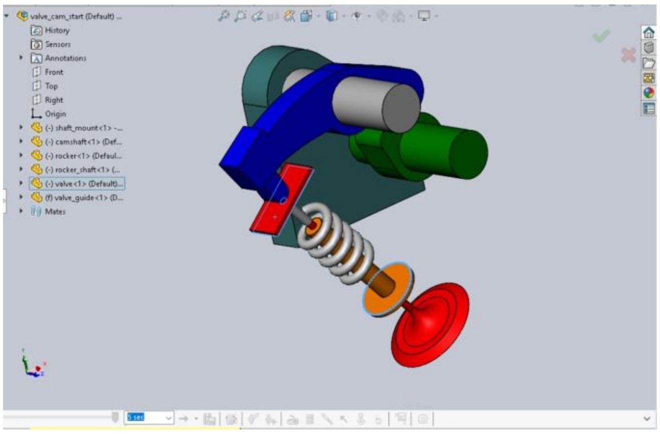

Figure 268 shows that I added a linear spring to the valve of the assembly.

Then, add contact to the components on the valve so later we can study the friction force and displacement values in motion analysis. The frame per second of the motion analysis is set to be 200.

Comment from Assessor

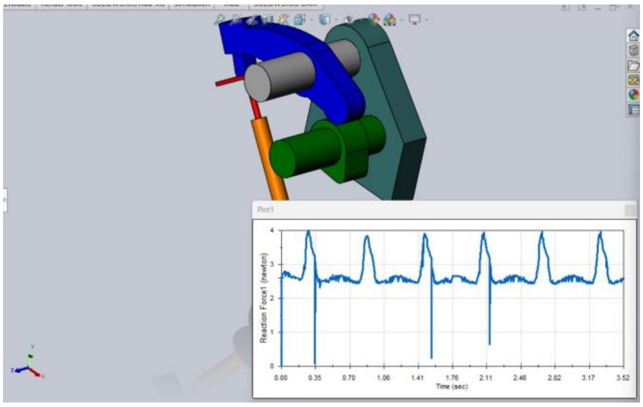

Figure 269 shows the diagram of the change in reaction force in newton per second and the contact region is the faces of the valve and the camshaft.

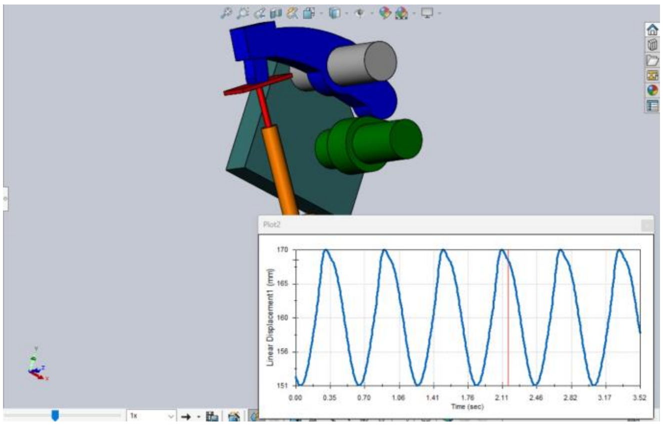

Figure 270 shows the plot of a graph of the change in linear displacement in mm per second.

Object moving along a path

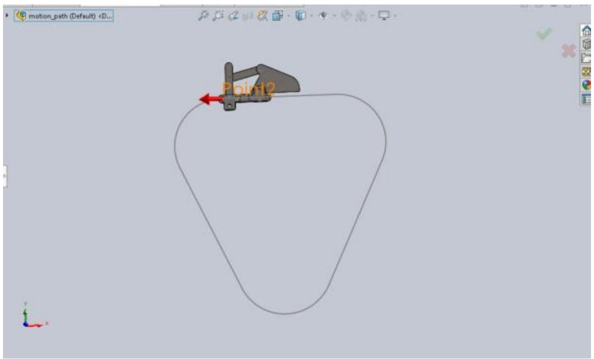

Figure 271 shows the exercise of moving along a path. The red arrow shown on the diagram indicates the motion direction of the object.

Comment from Assessor

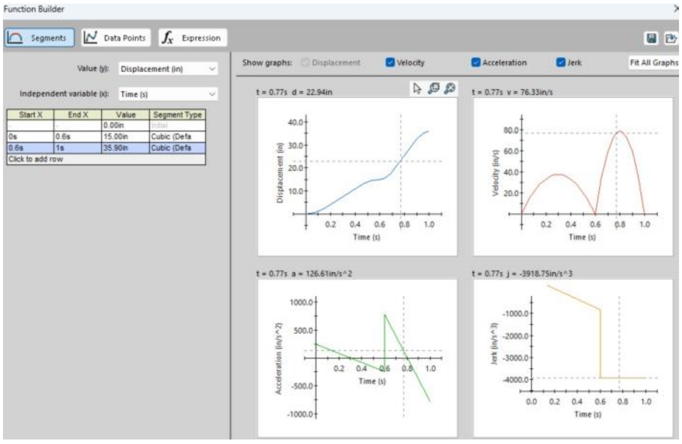

Figure 272 shows the function builder of the object.

The four graphs on the right allow us to predict the value of displacement, velocity, acceleration and jerk of the object when it is in motion. The table on the left allows us to change the value of the period of the starting position, ending position, the value and the segment type.

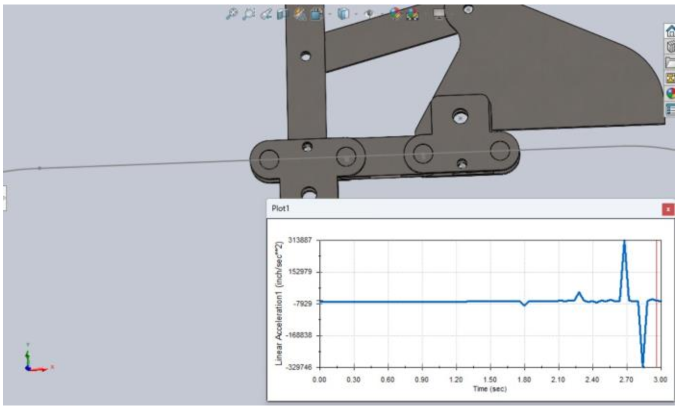

Figure 273 shows the plot graph of the value of the linear acceleration of the object as time passed.

Comment from Assessor

Solidworks 4 bar linkage design

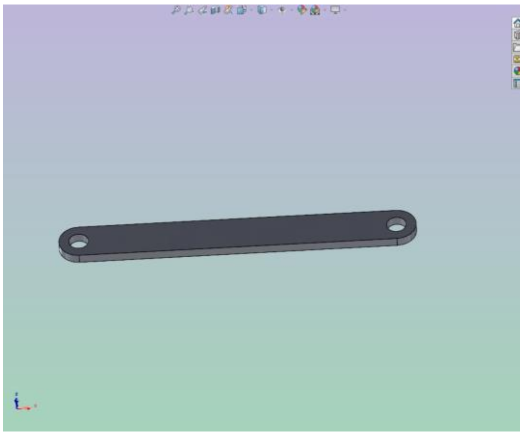

Figure 274 shows the bar 1 of the simple bar linkage.

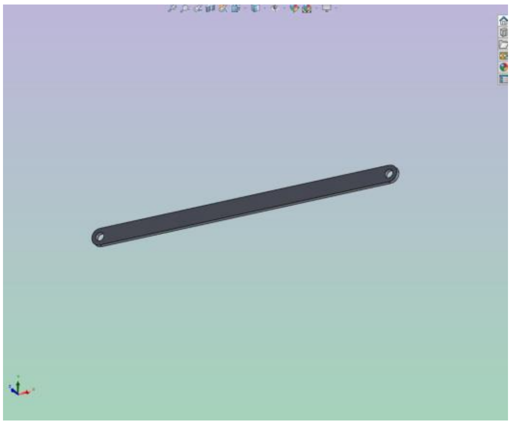

Figure 275 shows the bar 2 of the simple bar linkage.

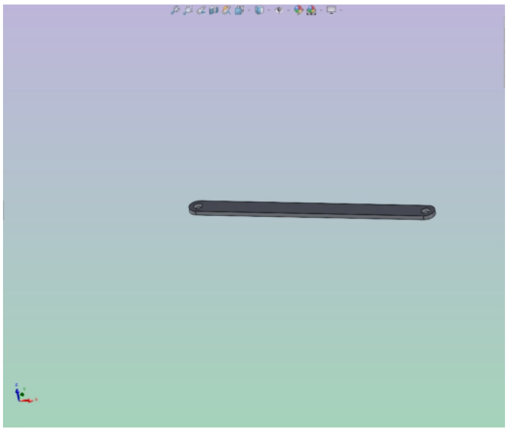

Figure 276 shows bar 3 of the simple bar linkage.

Comment from Assessor

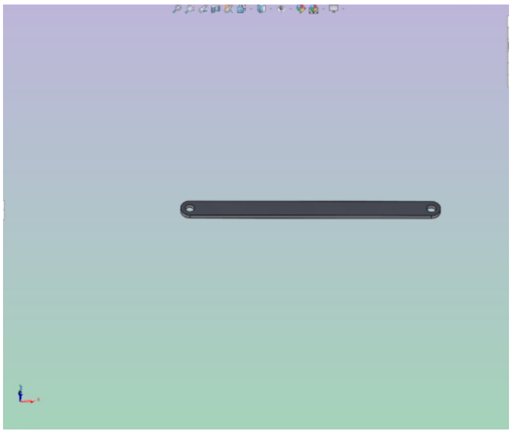

Figure 277 shows bar 4 of the simple bar linkage.

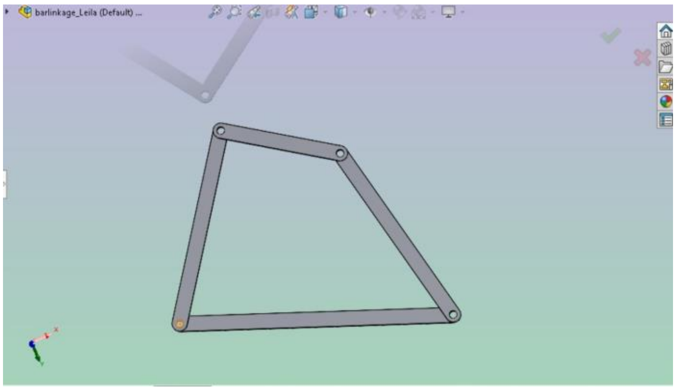

Figure 278 shows my design of the 4 bar linkage.

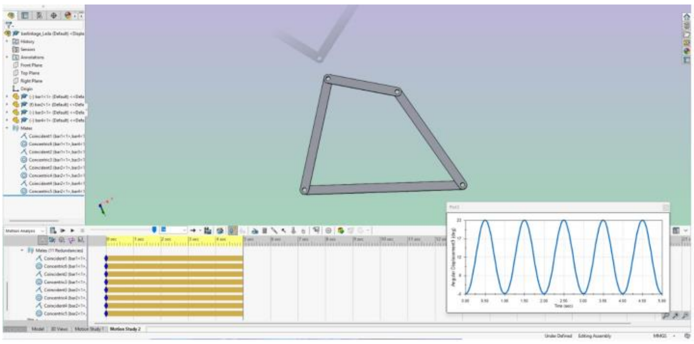

Figure 279 shows the angular displacement (in degree)-time (in second) graph of the motion analysis of the linkage.

Comment from Assessor

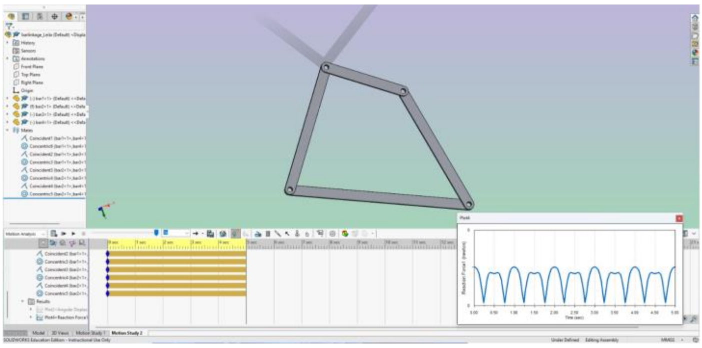

Figure 280 shows the reaction force to time graph of the motion analysis of the linkage.

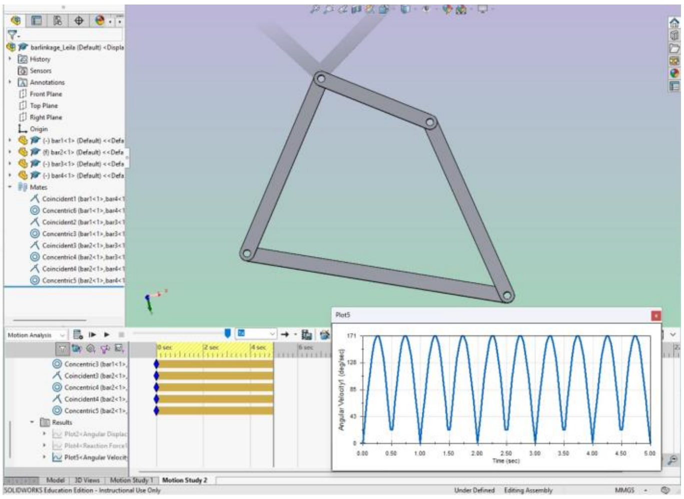

Figure 281 shows the angular velocity (in degree per second) to time (in second) graph of the motion analysis of the linkage.

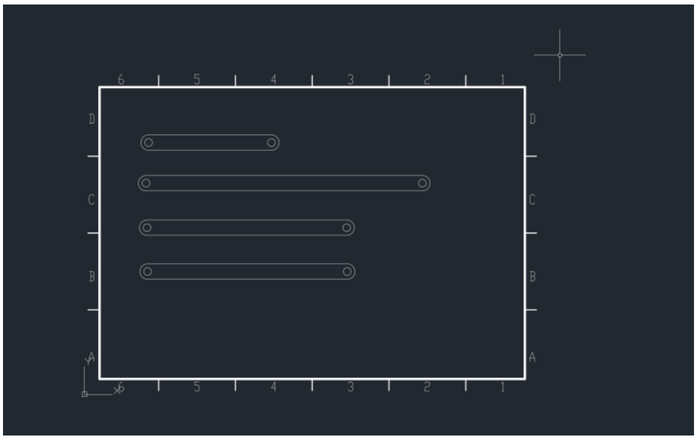

Figure 282 drawing sheet in Autocad version showing the size of the bar components. The sheet is in IOS 297mmx210mm.

Comment from Assessor

Training Activity on Day 2, on 25June 2024

On day 2, we learnt to use Solidworks to create our own 2.5D solid mold design in the morning and learnt to show the cutter path, generate toolpath which allows us to know if our designed mold can be successfully milled. The raw material of the mold is wax box and the size is 80mm x 50mm x 20mm. The cutter we selected are flat end and nose end cutter in a diameter of 3mm. The cutting depth per layer is 0.3mm and the maximum depth of cut is 3mm.

In the afternoon, we get familiarised with some basic skills of AutoCAD, such as drawing a circle or rectangle with specific dimension values in a specific place, and fillet.

Practice

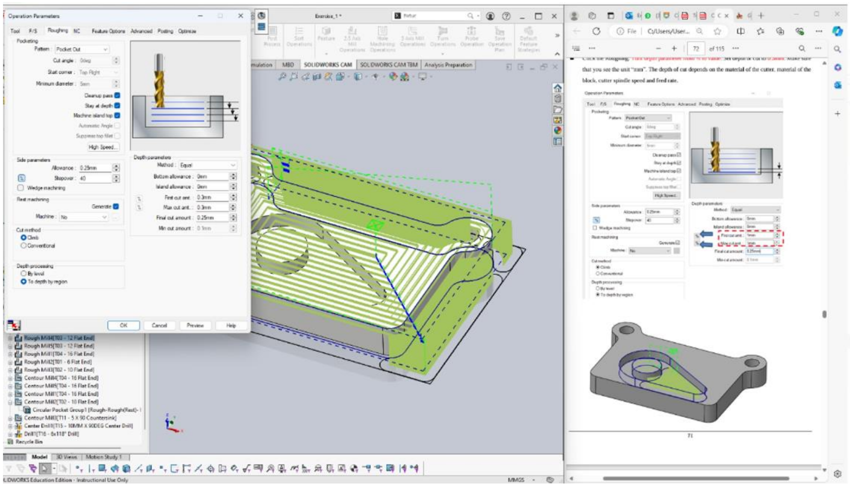

Figure 283

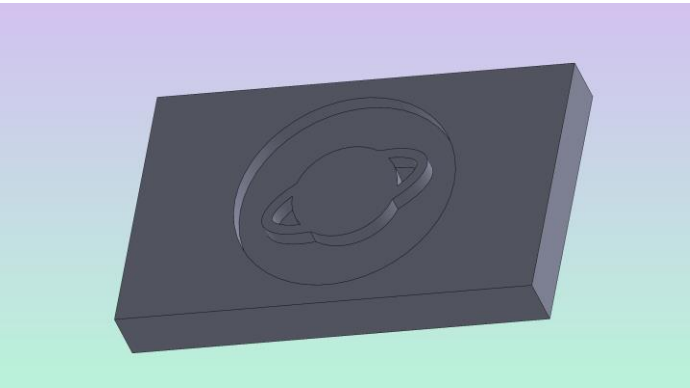

Figure 284 figure shows the Solidworks model of 2.5D designed solid mold

Comment from Assessor

Figure 285 shows the generate operation plan of the solid mold.

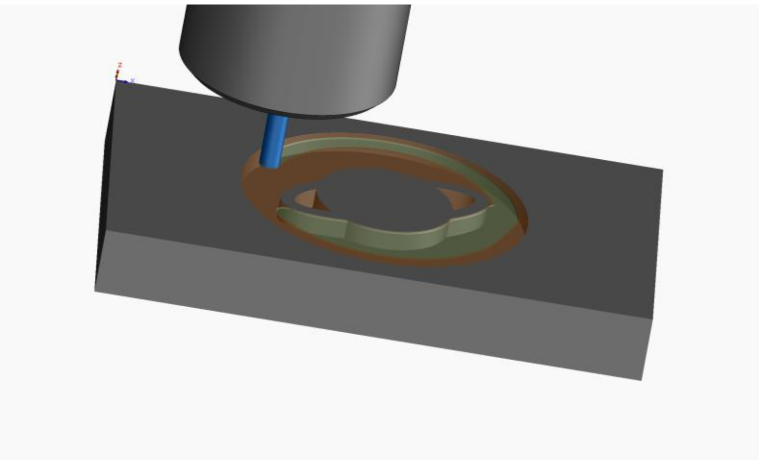

Figure 286 shows the generated toolpath

After the toolpath is created, the “Post Process” function can generate machine G-code of the toolpaths. The G-code is used by the CNC milling machine to mill the corresponding code. The G code controls every movements of the milling process, and it can be visually examined through “Simulate Toolpath” function to check if the process really aligned with the desired shape of our design. This preview helps us to reduce the material waste and time consumption so every step in the actual fabrication process goes in plan.

Comment from Assessor

Machining Parameters

Size of Workpiece: 80mm x 50mm x 20mm

Origin (0, 0) setting: Left corner of the stock

Sequence No.	1	2	3
Tool No.	1	2	4
Toolpath	Contour	Contour	Countersink
Cutter Size (mm)	20.000mm (Flat End)	3.000mm (Flat End)	5.000mm
Spindle speed (rpm)	3478.198	12000.000	8751.281
Feedrate (mm/sec)	57,97	44.704	48.902
Cutting Direction	Clockwise	Clockwise	Clockwise
Compensation (mm)	NIL	NIL	NIL
Machining Depth (mm)	10.000mm	10.000mm	10.000mm
Max. Rough Step of Depth cut (mm)	3.000mm	3.000mm	3.000mm
Number of Roughing Passes	Nil	Nil	Nil
Spacing of roughing Passes (mm)	Nil	Nil	Nil

Comment from Assessor

AutoCAD Drawing

In the afternoon we first learnt some basic functions of AutoCAD drawing. Then, we attempted to do the first task. We learnt about using different commands through searching the first letter of the word, and learnt about fillet, circle and rectangle drawing, dimension analysis, positioning and inputting textbox.

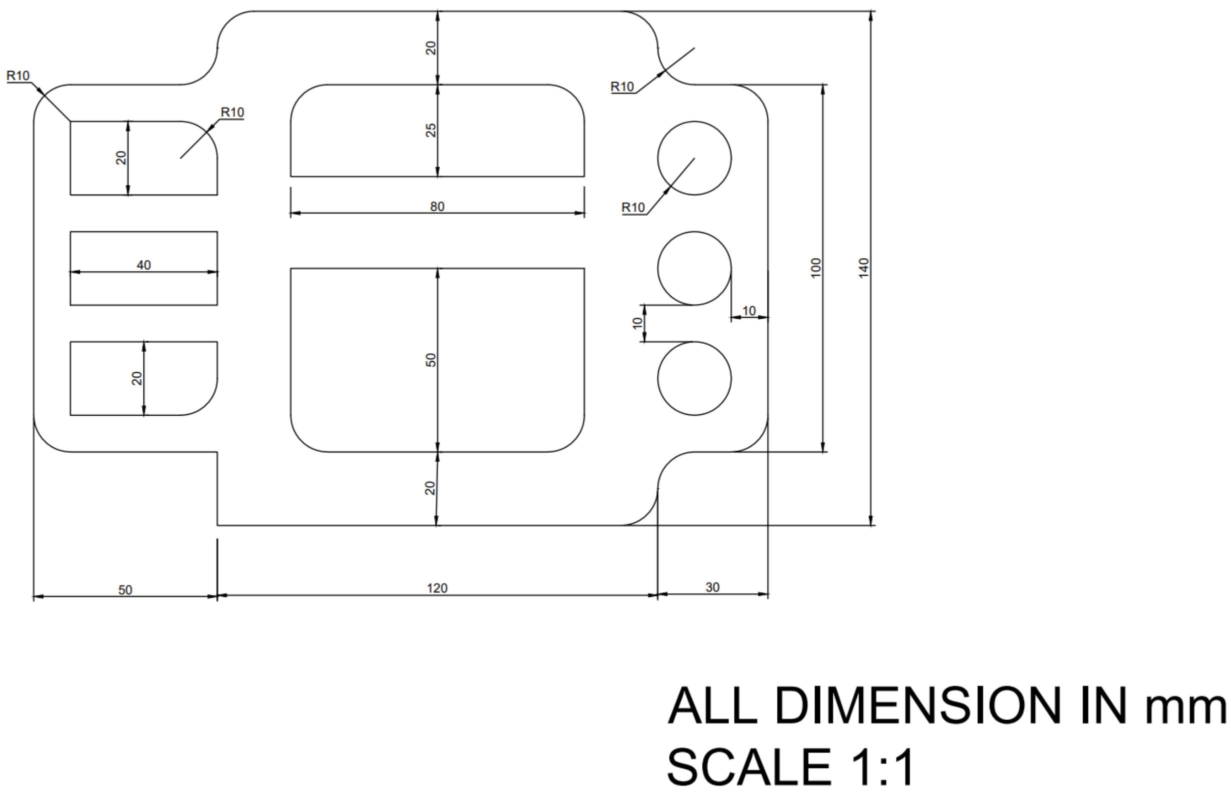

Figure 287 This is the finished version of task 1

Comment from Assessor

Training Activity on Day 3, on 26June 2024

On day 3 morning, we continue learning AutoCAD's various functions and practice drawing skills. On 25 July 2024, we learnt to draw the first AutoCAD drawing that is required to submit on moodle. The second drawing includes a lot more functions to use to draw different patterns. We are required to finish a Haking Wong G/F main switch room 'A' layout plan. We also learnt to use different layers to draw it, which is the main function we need as different layer with different thickness of line help us to better understand the patterns and structure of the drawing. Also, we can freeze a certain layer so the circle line can be hidden, leaving the required shape we need.

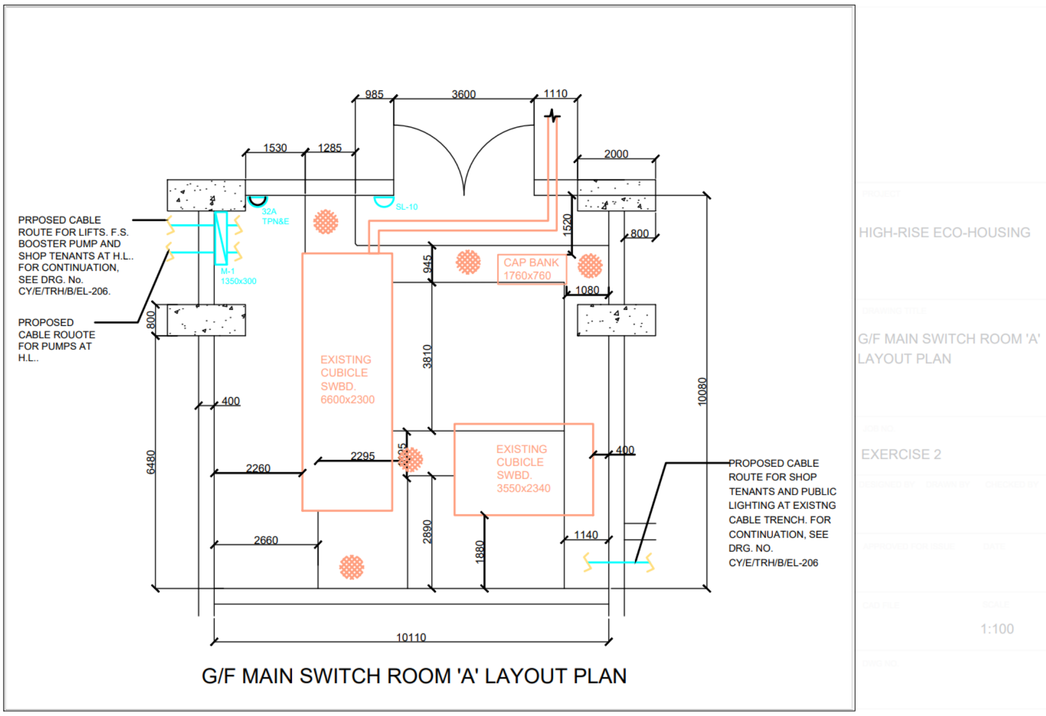

Figure 288 Task 2 of the AutoCAD assignment

Comment from Assessor

Training Activity on Day 4, on 27June 2024

On day 4 morning, we gathered in Haking Wong buildng G/F room 14 to do hardness test of the 3D printed L beam. We tested the supportable weight of L beam, then we calculate the ratio of the supportable weight to the beam weight.

L beam hardness test

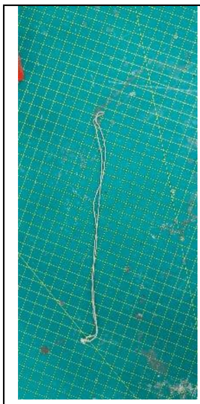

Figure 289 This thread is for holding the loads.

Figure 290 The payload of the L beam is 2283g

Figure 291 This my first design of the L beam. However, its weight exceeds the limit (22g)

The ratio of L beam's supportable weight to the beam weight is 103:1.

Comment from Assessor

Figure 292 The second L beam 3D printed model for hardness test. The weight is 16 gram.

Figure 293 The L beam is undergoing the hardness test

Figure 294 The test is supposed to be ended once it bends slightly. I continued putting more weights on the threads until it breaks.

Figure 295 This is the result when the L beam slightly bends. The payload of the L beam is 1283g.

The ratio of L beam's supportable weight to the beam weight is 80:1.

Comment from Assessor

Making a Clay Mold

The first step is to prepare the model clay and the roller.

Figure 296 Then, roll the model clay to form a flat surface.

Figure 297 Press the indenter into the clay.

Figure 298 Remove the indenter and make a strip which is to form a barrier on the clay. Next, mix the plaster powder with water and stir the mixture. Then fill the cavity with plaster.

Comment from Assessor

Figure 299 The clay model is made after waiting for a while for it to be solidified.

Heat processing test of metal

A metal heat treatment is demonstrated during the training session. Several heat treatment procedures are performed on two different types of metal. The metal is first heated to a certain temperature for specific length of time.

Figure 300 The oven for tempering test

Some heat treatment procedures involve several steps. A ceramic cup with metal cylinders inside is placed in an oven.

Comment from Assessor

Figure 301 Heating the metal cylinders

Figure 302 The metal sample is taken out of the oven after the heat treatment procedure ends. Then, it is taken out of the oven and allowed to cool naturally until it reaches room temperature. The plate must not be touched or it will burn your skin.

Figure 303 During the testing, the instructor needs to wear the heat-resistant gloves and a face mask appropriately.

Comment from Assessor

Finally, by using Vickers hardness tester, we can determine the hardness value of each sample. Here are the outcomes:

Heat Treatment	482 °C/30mins	482 °C/1hr	482 °C/2hrs	No treatment
Hardness (HRC), SKD11	51.0	52.0	54.6	15.2
Hardness (HRC), PH17-4	42.4	41.9	44.2	35.5

Figure 304 Vickers Hardness Tester

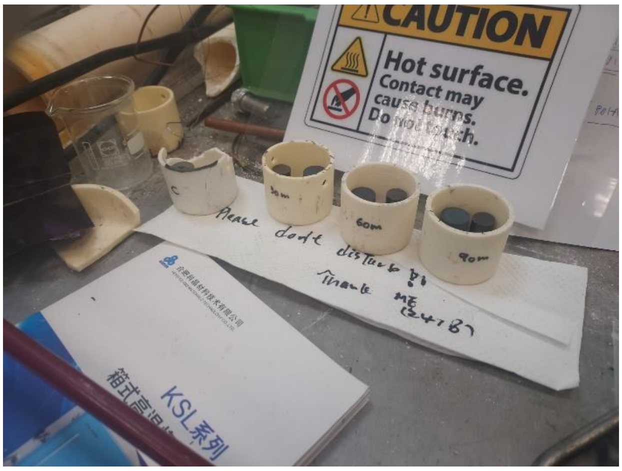

Figure 305 The heated metal cylinder is placed in the ceramic cup

Comment from Assessor

Wire EDM cutting machine

 Figure 306 Control panel of the cutting machine	 Figure 307 The structure of the machine	 Figure 308 Highly conductive metal wire for cutting

 Figure 309 The metal piece cut by the machine	 Figure 310 The cutting process

Figure 311 Grinding machine

Comment from Assessor

Training Activity on Day 5, on 28June 2024

On day 5 of the training, our instructor Mr. Felix, Mr. Vincent Lam and Mr. Frank Tse demonstrated us the mechanism of a 3D scanner, CNC milling machine, optical projector, 3D printers that printed our L beam model and PolyJets 3D printing which printed 3D models made of different kinds of plastics.

3D Scanner

A 3D scanner can scan a real-life object using laser beams to project light onto the surface of the object. It then collected the data of the scanned object and dislayed the physical dimensions and contours of that object.

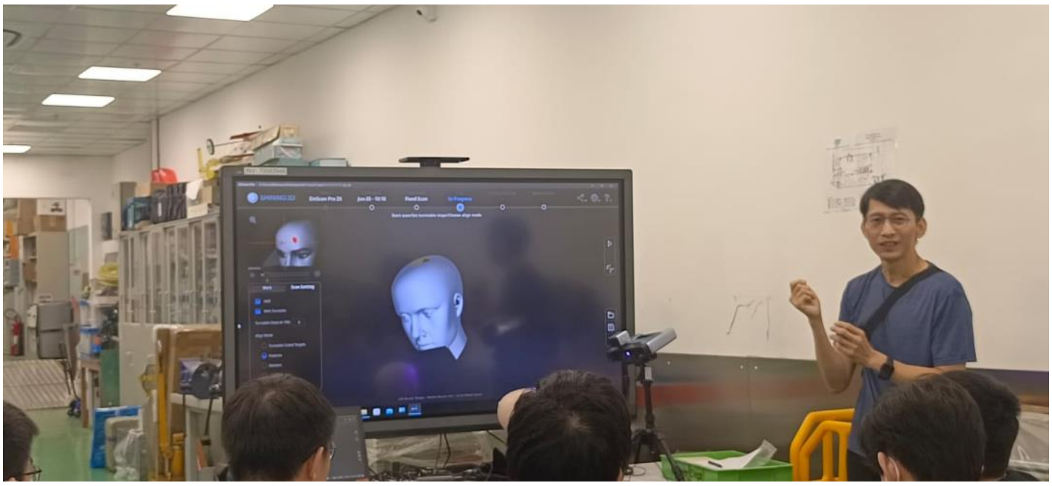

Figure 312 3D scanner

PolyJets 3D printing

Figure 313 Demonstration of the models

Comment from Assessor

Laser cutting machine

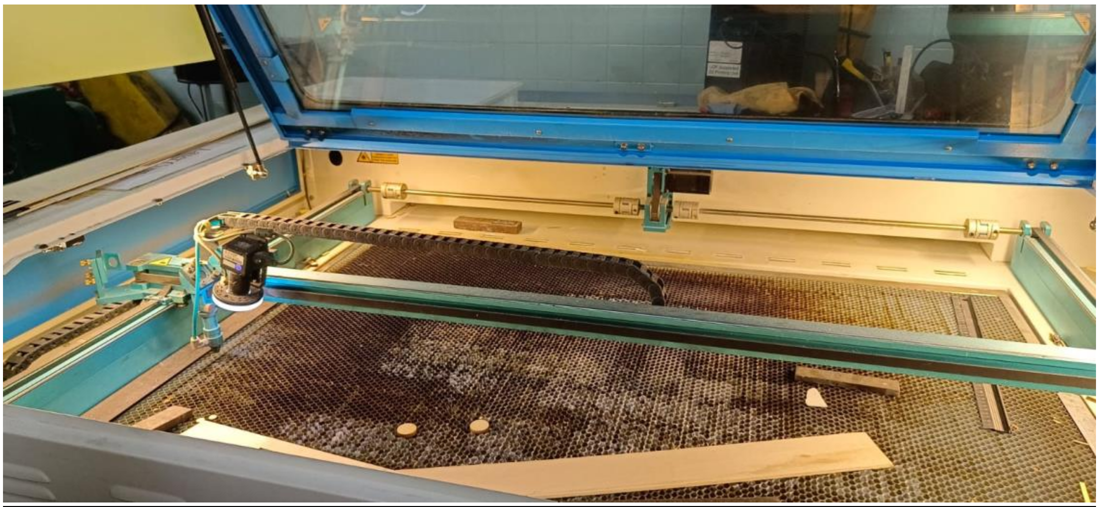

Figure 314 Laser cutting machine

Optical projector

The optical projector in G14 is Mitutoyo pj-3000. The advantage of this projector is that there is no direct contact with the objects, so it can be used for observing living organisms or fragile objects. The mechanism of the projector: There is a mirror at the bottom of the projector. The light beam goes from the light tube into the light refraction board, then it goes into the bottom part of the mirror, eventually reject into the top.

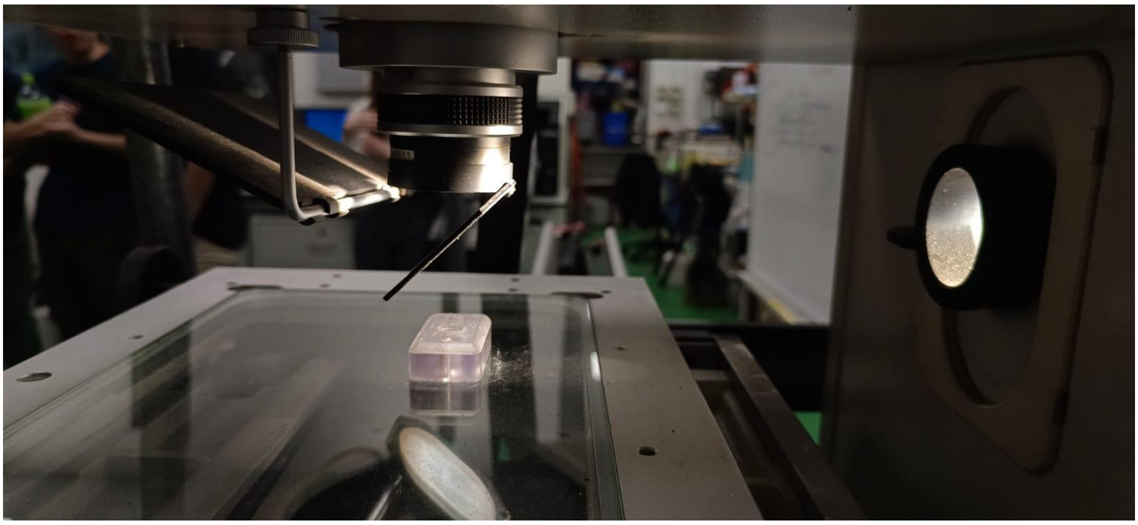

Figure 315 Optical projector

Comment from Assessor

CNC milling machine

A CNC milling machine is a automated machine that uses computer-controlled motors to move a cutting tool to cut shape workpieces precisely. We use G code as its programming language to perform the automation feature. During the training, the instructor (Felix) introduced us the working machinery of the CNC milling machine and demonstrated how it mills a plastic mold.

Figure 316 Demonstration of the CNC milling machine. However, due to time contraints, we are not able to print our own milling model

Comment from Assessor

Comment from Assessor

Summary for CAD/CAM

The CAD/CAM training session provides me an opportunity to further familiarize the use of 3D drawing software Solidworks through using their functions for different kinds of data analysis. For instance, with the use of finite element analysis (FEA), I am able to analyze and simulate the behaviours of some mechanical components and assembly and test for its hardness, the stability of the components' structure and systems under various loading conditions. It is a very effective way for us to do safety checking and analysis as all checking can be done on the computer, which saves time and cost for building a physical one in real life. I also enjoy the drawing process of a 3D components as it allows me infinite freedom to show our creative thinking and draw different kinds of structures that is hard to duplicate in real life.

Other Solidworks, we also learnt about Autocad software functions for the first time. I have a deeper understanding of the use of ACad software and using it to for drawings for engineering consultant works, such as learning to draw a part of the floor plan of G14 in Haking Wong building. This gives me a brief understanding on various engineering fields that we mechanical engineer could work in, and I feel more connected with tasks that are required to tackled in real life situation.

Moreover, instructors in G14 demonstrates us with various technology related to 3D data processing and manufacturing, including 3D scanner, CNC milling machine, optical projector, 3D printers that printed our L beam model and PolyJets 3D printing which printed 3D models made of different kinds of plastics. These machines give me a deeper understanding of various kinds of prototyping techniques, the advantages and shortcomings of each of them, and how they are essential for specific environments. These technology help saving engineers' time and effort in building them by their own in real life, and also raise the accuracy of the product measurement and manufacturing.

In conclusion, the CAD/CAM training module improved my understanding of computer-aided design and product design, which will be essential for me in the future.

Comment from Assessor

Summary of Seminar A-1

Seminar Topic:	Career as Marine Engineers in Ocean-going Sector and Marine Department
Date and Time:	7 June, 2024 from 2:30pm – 4:00pm
Speaker(s):	Mr. Ray Yuen, Surveyor of Ships, Marine Department

Summary of Activities

In this seminar, we learnt about the career path of marine engineers. The content of the seminar are divided into several parts, first it introduced what marine engineer do, the acquirement to become a professional marine engineer, the incentive schemes for students, career path and summer internship.

Mr. Yuen gave us a brief introduction on the type of ships which are often seen in Hong Kong, its usage and structures. Then we learnt about various kinds of components in ships, such as propulsion engines, boilers, utilities and refrigeration systems. We also had a basic understanding of the ranks of job position onboard, educational certificate requirements, training practice to become a marine engineer, summer internship programme promotion for undergraduates, and we perceived a better image on its career path. Finally, we identified the pros and cons of marine engineers, learn about the organization chart of the whole marine department, and the annual salaries of each position.

Comment from Assessor

Self – reflection

Mr. Ray Yuen gave us a clear insight into the job content of being as a marine engineer in Hong Kong. We rarely bring up information related to marine engineering field in our daily life and conversation, even though we study in engineering field. Therefore, through this seminar, I have gained a deep understanding of marine engineering and its work.

Mr. Yuen's talk is inspiring as it made me recognize the interesting part of being a marine engineer, and the importance and the impact of this field which greatly affects our society. Since Hong Kong is one of the main entrepot in the world, thousands of cargos and ships transport in here. The marine industry should be well developed to ensure smooth functioning of the ports every day. The components of the ships have to be well maintained and get regular check as well. I thought about the possible career paths which are related to marine industry, such as machinery manufacturing, and realized mechanical engineering students can contribute a lot in this aspect. Components like generators and propulsion engines seem to be an exciting production to study.

However, to become a marine engineer, there are many challenges that need to overcome, including the low salary payment during cadetship, different kinds of accidents like tsunami, hurricane or explosion in the ships that might occur at any circumstances, the decades of years of work and study to get to the top in the organization chart. Therefore, it is important to equip myself with professional engineering skills and knowledge to prepare for the future. This made me reflect on my current learning attitude and the goals I wanted to achieve, to become a professional engineer and contribute to industry.

Comment from Assessor

Summary of Seminar A-2

Seminar Topic:	Floating Production Storage and Offloading vessels
Date and Time:	7 June, 2024 (Friday) from 4:15pm – 5:45pm
Speaker(s):	David Llewelyn, FIMecheE, Chair of Scandinavia Group

Summary of Activities

In this seminar, Mr. David Llewelyn talked about the definition of offshore oil and gas production, the FPSO (Floating Production Storage and Offloading) units around the world and the impacts of oil and gas production on the environment and society. He also gave us a detail explanation on the components of FPSO, and the roles of engineers in this industry, such as structural design, design evaluation, key technologies and solutions to improve FPSO, like external and internal, connectable and disconnectable turrets systems and swivel. Mr. David provided detailed illustrations on the working principle of the turret system, and its components and structures, including main internal turret mooring and fluid transfer components, and the mechanism of the turret, simplified swivel arrangement and swivel stack modules.

Then, Mr. Ho talked about the FPSO Riser and mooring systems and offloading and explained the function of these systems with real life examples from different countries. Different kinds of risers and anchors are discussed, and he explained the engineering analysis for tackling water depth and metocean conditions. Lastly, the seminar emphasized the importance of the role of engineers in FPSOs through several factors, including ongoing innovation and creative design, quality manufacture and commissioning and operation.

Comment from Assessor

Self – reflection

The topic of this seminar is really intriguing and gave me many interesting insights about FPSO (floating production storage and offloading) unit. I obtained a lot of professional and valuable knowledge related to offshore oil and gas production around the world. In the seminar, the details of FPSO including its structure, components, how innovative solutions help it to adapt the water depth and metocean condition issue are discussed. These all gave me a detailed description about offshore gas and oil production and I have a deep comprehension on the roles of the engineers working in marine industry that is related to FPSOs.

The most interesting part of the seminar for me would be the part where engineers came up with the key technology, turret and swivel system which allows FPSO to weathervane and align with changing wind, wave, and current conditions while maintaining connections to subsea infrastructure like risers and mooring lines. It was really impressive for me to understand how these gigantic structures are designed to withstand the harsh offshore environment.

Moreover, this talk gave me a valuable experience on recognizing how diverse the range of engineering disciplines involved in FPSO projects is. I also realized that for such a massive project, engineers from different disciplines have to work together to achieve the goal. For example, other than mechanical and marine (offshore) engineers, electrical, control systems, naval architecture and corrosion engineers are playing a crucial role in this project.

Overall, throughout this seminar, I learnt about now amazing these spectacular projects are through collaborations that are done by engineers from various disciplines. I appreciate the team spirit demonstrated in these works which benefits our society. I also believe it would be wonderful if there would be more talks introduce different kinds of engineering discipline such as mining and geological engineers, nuclear engineers and material engineers to let students have more insights in these interesting and unique fields.

Comment from Assessor

Summary of Seminar B-1

Seminar Topic:	Occupational Safety & Health
Date and Time:	28 June, 2024 (Friday) from 2:30pm – 4:00pm
Speaker(s):	Dr. Authur Leung, Assistant Director of Safety, Safety Office, HKU and Dr. Connie Ng, Senior Safety Office of Laboratory Safety Team, Safety Office, HKU

Summary of Activities

The seminar is held in MWT Room 1. In this seminar, the talk is divided into three parts: the first one is General safety talk conducted by Dr. Authur Leung. This talk introduced general hazards and risks in the university, and a brief explanation of the occupational safety and health ordinance in school. Various kinds of images and news are given to further illustrate the meaning of different kinds of hazards risks, and that concludes accidents could happen in anytime and anywhere. At last it introduced the legislation and policies regarding safety and health of HKU.

The second talk is about laboratory safety rules conducted by Dr. Authur Leung again. It introduced basic laboratory safety rules with multiple images, and the waste disposal ordinance.

The third talk is about the safety briefing for the department of mechanical engineering, which is conducted by Dr. Connie NG. The talk mainly introduced the hidden hazards that could occur in school laboratory, workplace and in engineering industry.

Comment from Assessor

Self – reflection

This seminar provides detailed and important reminders about the safety issue in school laboratories and engineering industries. This talk has been a very valuable experience for me, especially after the week of workbench practice. The news Mr. Leung has included in the slides recalls my experiences during workbench practice session, when we were handling different kinds of powerful machines, sharp-edge tools and other heavy equipment. I have clearly recognized the importance of arranging safety as the prior factor to consider when it comes to the tasks in the industry where dangers may occur at all times. A little careless action may lead to serious disasters, from mild injuries such as hearing loss and eyesight damage, to irreversible tragedies, such as death.

To avoid these accidents, I understand that good communication between colleagues and an active contact with the supervisors are crucial when it comes to working with powerful machineries. It greatly helps when we are conducting a group projects, as colleagues could look after and remind one another about the safety rules that we sometimes neglected, and we should let our instructor or supervisor know and keep track of our progress, so accidents can be prevented by immediate actions before it happens. Moreover, the ordinance and rules introduced in the seminar help us to be able to clearly identify the potential hazards in workplaces, so we can greatly mitigate risks and sustain a safe environment for everyone.

To conclude, this seminar gave me a deep understanding of the importance of safety and occupational health in the engineering industry. I would not forget the experience of this talk, especially the news about the death of a research assistant due to the use of pyrophoric chemical in university of California, Los Angeles. Since the study of materials is also a part of the mechanical engineering branches, this kind of accident may occur again in future if there are no careful handling of the chemicals. I recognize that this is my responsibility as a student to pay attention to the surroundings, and follow the safety rules during experience and work, and observe if any dangerous factors such as flammable materials is not sorted and handled safely. It is essential to foster and maintain a safe and secure environments for myself and colleagues in laboratories and workplaces.

Comment from Assessor

Summary of Seminar B-2

Seminar Topic:	Occupational Health and Professionalism
Date and Time:	28 June 2024 (Friday) from 4:15pm – 5:00pm
Speaker(s):	Dr. Match W. L. Ko, Department of Mechanical Engineering, HKU

Summary of Activities

This seminar gave a detailed introduction on various types of occupational hazards and accidents. Dr. Ko also introduced an impressive workplace organization technique called 5S which refers to Sorting, Set, Shine, Standardize and Sustain. The talk mentioned the advantages of 5S and its usage, and a concise and detailed explanation on how each step can be implemented and ways to start and achieved the target of the effect that is brought by 5S. Examples of 5S implementation are provided to give us a better understanding of this ideology. The examples proved the importance of having a good housekeeping practice in all kinds of environment, including home, school, laboratories, workplaces and public areas.

The next part of the talk introduced engineering professionalism and ethics in this industry. It talked about the importance of ethics of engineering, how ones can become a profession in engineering field through knowledges, experiences and practices. There are also rules of behaviour for engineering industry, which includes etiquette, laws, morals and ethics. Finally, the talk reminded everyone about the important manners and rules to be followed to become a professional engineers.

Comment from Assessor

Self – reflection

The content included in this seminar provides one of the most important skills that a student should acquire to become a professional engineer in the field. It categorizes occupational hazards in various ways, which again emphasizes the importance of prioritizing safety in every occasion to create a safe and secure environment for colleagues. The 5S ideology also gave me a good inspiration on self-management. It is also highly effective for team management and improves work efficiency as tidying up the place increases productivity and makes people feel fresh and motivated, hence improving working quality as well. Throughout the seminar, we also discussed the ethics of engineering, the importance of practicing them through knowledge, experience and practice to become a professional engineer. As an engineer, I realize that sometimes it is difficult for the general public to understand my professions and knowledges, and I discovered that the communication skill when we are interacting with people from different background is profound and takes a long time to be proficient in it, therefore, to foster a good communication environment between colleagues and the public is crucial, and also requires us to practice more. By applying 5S in teams, and practicing engineering ethics, we would be able to create a productive environment with motivation while maintaining passion and faith among colleagues.

Moreover, the fundamental canons and moral codes are the crucial obligations we should follow as an engineer. Just as mentioned in the seminar, engineers rarely work alone. Every action and interaction we made will make an impact on our work efficiency, the relationship between colleagues, our productivity which hence affect the quality of the work and products we provide. When these products are promoted in society, it impacts not just the company’s reputation and incomes, but also society as the general public is using products we made and tested. Our contribution to society greatly determines people’s quality of life, for example, we should follow moral rules such as abiding the principles of integrity to foster a good relationship between colleagues and guaranteeing the quality of the products we made.

Therefore, everyone should follow the interaction rules to become a professional engineer, and treat it as a daily etiquette to practice and master the art of engineering ethics.

Comment from Assessor

Summary of Seminar B-3

Seminar Topic:	Road to become a Professional Engineer
Date and Time:	28 June, 2024 (Friday) from 5:00pm – 5:45pm
Speaker(s):	Dr. Benjamin P. L. Ho, Department of Mechanical Engineering, HKU

Summary of Activities

During the seminar, Dr. Ho talked about the process of becoming a professional engineer in Hong Kong. To become a chartered mechanical engineer in future, there is a standard process that is required for mechanical engineering students to follow, including passing the necessary tests and exams, accumulating a certain amount of training hours and experiences, practicing obligations to satisfy the requirements for applying to become a chartered professional engineer.

There are also several ways to become a chartered engineer in a certain discipline in engineering. The quickest and most well-known way for local university graduates is to apply “Scheme A” and fill out tasks offered by the Hong Kong Institution of Engineers (HKIE) to become a professional in a particular field. Then, we need to apply for positions certified by the institution, and keep a full set of logbooks to record and display the duties and obligations we tackled during years of training with the companies we work in. Then, we can apply for the member qualification and officially become a mechanical engineer in HKIE after reaching all the requirements.

Comment from Assessor

Self – reflection

This seminar is an exceptionally meaningful experience for everyone who joined. It gave us concise and helpful insights on our career prospects, giving us detailed information for us to plan what we want to do in future. Whether it is to become a professional engineer after we graduate, or pursue further study in Hong Kong or overseas, Dr. Ho gave us useful ideas and clear directions to help us sort the confusion for future planning. I realized that in Hong Kong, the most direct path to become an engineer is applying through Scheme "A" training. However, it requires years of training and tackling different tasks offered by HKIE, therefore, obtaining a certificate qualification from an authorized company can be challenging.

Moreover, we also need to think about where our interests are at, our strength and which sector suit us more. There are many types of engineering that we could choose in the engineering industry, therefore, I realized that it is important to have a certain depth of understanding in a certain field. For instance, to achieve all requirements in energy and environmental engineering, I will need to take most related courses to dive deeper in this field, which helps me to make necessary steps towards becoming a professional engineering that field.

Nonetheless, Scheme "A" training offers limited choices in the engineering sector, so some of our interested field may not be offered by this scheme. This may hinder the choices of my future career, so careful consideration must be taken before our last year of study in university.

In a nutshell, becoming a professional engineer is a complex and challenging process but with great determination, I believe everyone could achieve it. I also recognize that it is important to continue equipping myself with diverse knowledge, work experience and training to allow me to have more choices for my career path. This seminar guides me to learn and adapt the challenges and grasping opportunities that appears in my career path.

Comment from Assessor