



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CLB 21303
COURSE TITLE : PROCESS INSTRUMENTATION & CONTROL
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY
WITH HONOURS
DATE : 29 JANUARY 2026
TIME : 2:00PM - 5:00PM
DURATION : 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 9 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Basic or fundamental knowledge of Pressure for Fluids that normally covers both Liquid as well as Gas is to be considered as very important aspect of knowledge before one get to know or learn the usage of different types of Pressure Measurement Devices inside the Plant. Without having this basic knowledge of Pressure, it is obviously will cause some not only difficulty to explain the principle behind Pressure Measurement but also to relate between the Principle of Pressure with how the Instrument works in carrying out Measurement. It is only when this fundamental knowledge has been fully covered and truly understood, then the understanding of Principles of Operation for variety of Pressure Measurement Devices will be much easier.

- (a) Describe briefly the basic characteristics of the following types of Fluids.

i. Liquid Pressure. (5 Marks)

ii. Gas Pressure. (4 Marks)

(9 marks)

- (b) Basically, any type of Pressure Measurement Devices can be known as Pressure Transmitter that consist of two parts or elements. This is especially true for the type of device that has electrical extension connection with Controller. Explain briefly EACH element of Pressure Transmitter. (4 Marks)

(4 marks)

- (c) Briefly explain the principle behind Manometer as one of Pressure Measurement Device. (3 Marks)

(3 marks)

- (d) i. Simplified diagram needs to be produced that clearly shows a vessel or container which the Pressure is to be measured. Include in the diagram the Pressure Measuring Device with the abbreviation P. (2 Marks)
- ii. Suggest the most possible type of Pressure Measuring Device being chosen in part (i.) together with its justification. (2 Marks)

(4 marks)

Question 2

Level Measurement is to be considered as important measurement. This is especially since, without knowing the level of substance or Liquid inside the tank we are not particularly sure whether the substance that is temporarily stored is sufficient or not. For that matter, the Operator needs to regularly check and monitor the level of substance inside the tank. In order to do that, Level Instrumentation is very essential. There are basically two ways or methods of measuring the level either through Direct Level Measurement or Indirect Level Measurement. Direct Level Measurement normally can be done by simple type of Level Instrument such as Dip Stick, Float Device and Sight Gage Glass. On the other hand, Indirect Level Measurement normally involves sophisticated electronic instrument which can be done by Differential Pressure, Capacitance and Conductivity Measurement.

- (a) Briefly discuss the concept of Indirect and Direct Level Measurement.

(6 marks)

- (b) i. Sketch a simplified diagram of an Open Tank that clearly shows Level Measurement Installation. Fully label your diagram. (6 Marks)
- ii. By referring to the diagram sketched in (i.), discuss in brief the method of Level Measurement being used for this Open Tank. (4 Marks)
- iii. By using your experience and knowledge of performing Experiment#3: Level Measurement, compare and contrast between Level Measurement being used for a Closed Tank and an Open Tank. (4 Marks)

(14 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Final Control Elements (FCE) normally consist of mostly in the form of Valves although sometimes can also consist of Pumps or Compressors and very rarely comes in the form of Heat Exchanger or Condenser. For Valves, there are so many types which can be broadly classified into Most Common types and Less Common types as far as Chemical Industry is concerned. Valves are to be considered as among the most important device that are not only directly connected with Controller but also as the last resort not only to ensure the Setting Parameter managed to get back on track in ensuring the pre-determined Production Specification but also for Safety Point of view. This is since by manipulating the Valves be it Automatically or Manually give a chance or minimizing threats or danger due to when the Process is already Unstable and beyond Control.

- (a) Selection of Valves very much relies on these factors namely, Service Conditions, Intended Tasks and Load Characteristics of Application. Explain in brief all these factors. .

(6 marks)

- (b) i. You need to perform a Task of producing a simplified and fully labeled diagram for a simple system that consists of a Boiler or Heater with one Incoming Stream or Pipeline and also two Outgoing Pipelines. One Pipeline is for discharging Steam while another Pipeline is to remove Condensate from the System. For Steam Discharging Pipeline, there is a By-pass Pipeline to be included. Also, you are required to insert Valves in the Diagram..(6 Marks)
- ii. Using Diagram in (i.) as reference, you need to further identify the Valve being selected either On-Off or Regulating Valve. Justify your answer. (3 Marks)
- iii. Referring to your answer in (ii.), examples of specific type of Valve that are worth to be utilized in the already sketched Diagram need to be declared. (5 Marks)

(14 marks)

Question 2

Another type of Final Control Elements (FCE) that is normally not as important as Valve is Pump or Compressor. Pump is the type of device that is being used to deliver or distribute Material or Substance in the form of Highly or Viscous type of Liquid. On the other hand to deliver Substance in Vapour or Gas Phase require the usage of Compressor, In general, there are two broad classifications of Pump namely, Dynamic type and Positive Displacement type. For that matter it is very basic or essential to both know and identify the classification of Pump or even Compressor to be correctly utilized in order to guarantee or be sure of the Plant operates as intended with minimum or even zero interruption.

- (a) i. Partial or total failure in the performance of Pumps or Compressors are both a possibility as well as inevitable. For that matter, you are required to explain in brief the symptoms that indicates this possible situation. (2 Marks)
- ii. Description briefly both Horizontal and Centrifugal Pumps that are examples of Pump under the classification of Dynamic Pump. (4 Marks)

(6 marks)

- (b) i. You need to come out with a sketch of both simplified and also fully labeled diagram in order to illustrate a simple system that consists of a Tank or Vessel that acts as a Mixer with two Incoming Streams or Pipelines and also one Outgoing Pipeline. The Mixing Liquid inside to Tank is to be discharged whenever the Level already exceed the Maximum Allowable Level. (6 Marks)
- ii. By referring back to Diagram in (i.) you need to identify the most possible location to include two Pumps. Justify your answer. (3 Marks)
- iii. By referring to your answer in (ii.), examples of the most possible types of Pump to be utilized in the already sketched Diagram needs to be given. (5 Marks)

(14 marks)

Question 3

In Process Control, there are varieties of patterns of incoming as well as outgoing streams. The simplest is one incoming and one outgoing streams. The medium type is two incoming but one outgoing streams. The complex type is more than two incoming and also more than two outgoing streams. Therefore, to simplify matter, it is convenient to classify these streams into Input and Output Stream. Each carries with it the parameter or Variable in the form of Flowrate, Temperature, Pressure, etc.

- (a) i. Identify the type of Variable that is directly subjected to be controlled by Controller. (1 Mark)
- ii. Give suggestion the approach that you take in order to carry out differentiation between *Manipulated* and *Disturbance Variable* for *Input Stream*. (5 Marks)
- iii. Similarly in (ii.), give suggestion the approach that you take in order to carry out differentiation between *Measured* and *Un-Measured Variable* this time under *Output Stream*. (4 Marks)

(10 marks)

- (b) Refer to the following table and answer the questions
- i. You are required to give brief explanation about the overall trend of result from $MV = -0.63\%$ until $MV = 70\%$. (3 Marks)
- ii. If the experiment is conducted with an addition of MV between -0.63% and 50% , explain briefly the trend of result that is predicted to occur. (3 Marks)
- iii. There is doubt of Result for the Row of Mass Flowrate Recorder Channel 1. You are required to analyze this result in order to come out with the most logical explanation. (4 Marks)

Refer Below - Table1 : Experimental Result For Air Flow Process Control .

(10 marks)

Table 1: Experimental Result For Air Flow Process Control

Controller Reading	MV = -0.63%	MV = 50%	MV = 70%
Main Face Plate, F_m , kg/hr	52.1	37.2	24.7
Main Face Plate, F_v , m ³ /hr	22.1	12.6	7.9
Recorder Channel 1 F_m , kg/hr	25.0	21.8	28.2
Recorder Channel 2 F_v , m ³ /hr	22.1	12.7	8.0

Question 4

Proportional, Integral and Derivative or better known as PID Control is to be considered as Generic Control Method as well as Workhorse in the World of Automation. As evidence, it can be said that 99% of all Automation Control Loops come in the form of PID Control. What is actually PID Tuning at the first place? PID Tuning actually refers to Workflow in search of PID Parameters are determined based on three possible sources namely PID Algorithm being used, the Open Loop Process Behaviour and finally the Engineering Specifications of the preferable Closed Loop Behaviour..

(a)

- i. Based from your experience in performing Process Control Laboratories in general, select one possible source from the given text that has more weightage in obtaining the best possible PID Parameters. Justify your answer. (3 Marks)
- ii. Again, based on your experience in performing Exp#2: Air/Gas Pressure Process Control, briefly explain the conclusion that Optimal PID Tuning has been achieved. (4 Marks)
- iii. Briefly describe the source of Engineering Specification given in the above text in relation to your experience in performing Process Control Experiments in general. (2 Marks)

(9 marks)

(b) Analyze the given Figure of Results for Experiment#2: Air/Gas Pressure Process Control and answer the following questions.

- i. Give briefly your comment based from Figure 1. (3 Marks)
- ii. If the experiment to be repeated with Double Capacity Process and still under Trial 1, explain briefly the most possible Response that you will obtain. (3 Marks)
- iii. During conducting the experiment, the procedure requires the usage of Larger Proportional Band (PB) and also Larger Integral Time (TI). Briefly discuss the possible outcome of Response that you will obtain. (4 Marks)
- iv. Based from Figure 1, identify the Characteristic Of The Process. (1 Mark)

Refer Below - Figure1 : Response Of Trial 1 Single Capacity Process .

(11 marks)

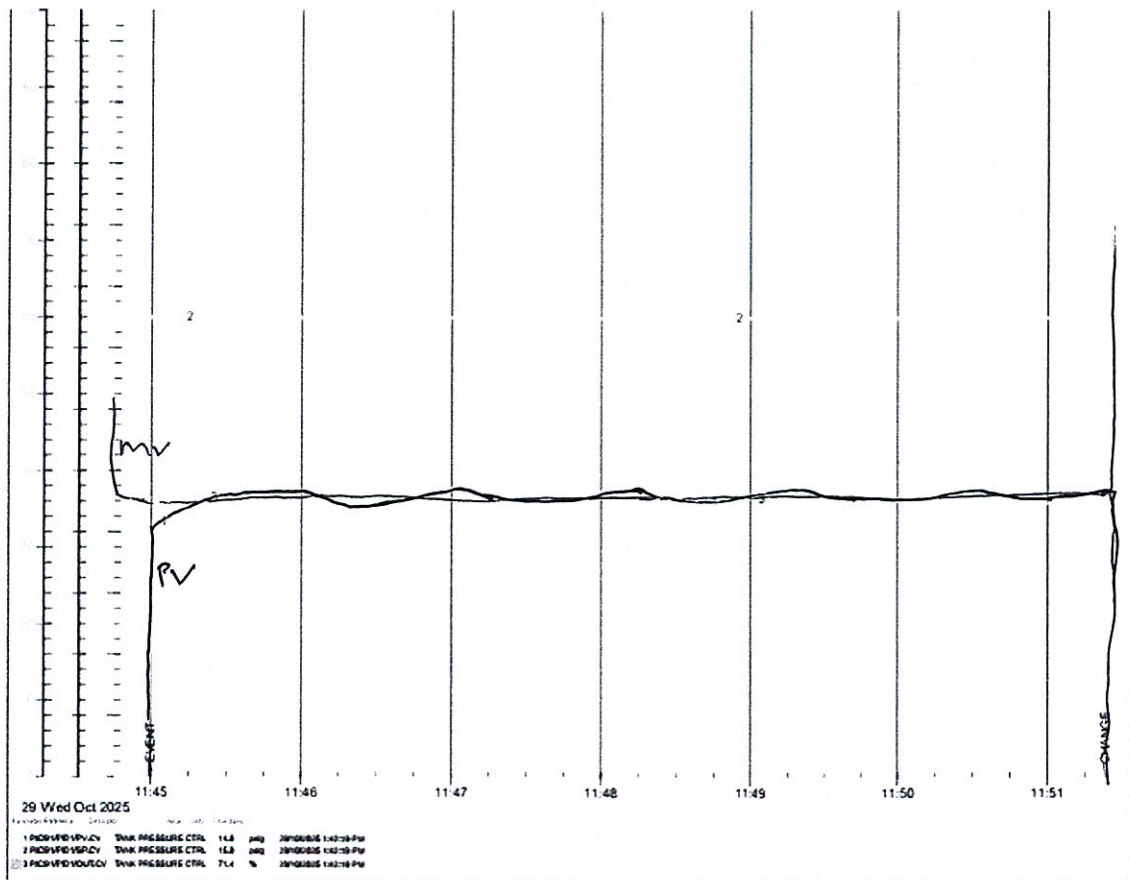


Figure 1: Response Of Trial 1 Single Capacity Process

END OF EXAMINATION PAPER

