



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

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CPB 22403
COURSE TITLE : PROCESS INSTRUMENTATION AND CONTROL
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY
WITH HONOURS
DATE : 29 JANUARY 2026
TIME : 2:00 PM - 5:00 PM
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 concerning Temperature is to be considered as very essential aspect of knowledge before one get to know or learn the usage of different types of Temperature Measurement Devices inside the Plant. Without having this basic knowledge of Temperature, it is obviously will cause some not only difficulty to explain the principle behind Temperature Measurement but also to relate between the Principle of Temperature 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 Temperature Measurement Devices will become much smoother.

- (a) Describe briefly showing the direct relationship between Internal Molecular Activity of any Substance with Temperature.

(7 marks)

- (b) In general, Temperature Measurement Devices can be known as Temperature Transmitter that consist of two parts or elements unless if it is a standalone type of device which the Output or Temperature Value can be clearly shown at the Dial. This is only applicable for the type of device that has electrical extension connection with Controller. Briefly explain EACH element of Temperature Transmitter.

(5 marks)

- (c) Explain in brief regarding the principle behind Filled System as one of Temperature Measurement Device.

(4 marks)

- (d) i. Produce a sketch of a Simplified diagram that shows clearly a vessel or container which the Temperature needs to be measured. Show the presence of Temperature Measuring Device with the abbreviation T. (2 Marks)
- ii. Come out with suggestion the type of Temperature Measuring Device most suitable in being selected in part (i.) together with its justification. (2 Marks)

(4 marks)

Question 2

In general, Measurement of Properties or Parameters of Substance mostly when the Substance is static or non-moving. This is the usual case when measuring the Substance Pressure and Temperature. However, in some other instant the measurement is to be done when the Substance is moving at first and sometime elapse is allowed in order to wait for the Substance to become static before any measurement is to be made. This is typical of Level Measurement. Finally, the most challenging Measurement effort is to be done while the Substance is continuously moving or non-static. This is the case for Flow Measurement whether the Substance is in Liquid or even in Gas or Vapour Phase.

- (a) Explain briefly the following concepts to be considered under Flow Measurement
- i. Ideal Liquid. (3 Marks)
 - ii. Ideal Gas (3 Marks)

(6 marks)

- (b)
- i. Produce a sketch of simplified and fully labelled Diagram indicate a Vessel together with Incoming and Outgoing Pipelines. Include in the Diagram Flow Measurement Device at Incoming Pipeline. (6 Marks)
 - ii. By referring to the diagram in (i.), discuss in brief the method of Flow Measurement. (4 Marks)
 - iii. Utilizing your experience in performing Experiment#4: Air/Gas Flow Process Control, briefly discuss the type of Flow Measurement Device in use. (3 Marks)
 - iv. If there is another Flow Measurement Device that can be used as an alternative for Experiment#4: Air/Gas Flow Process Control, explain briefly the alternative Flow Measurement Device. Justify your answer. (3 Marks)

(14 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

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. Pumps or Compressors has the possibility of either partial or total failure in its performance. Briefly explain the symptom that indicates this situation. (2 Marks)
- ii. Give brief description of both these examples of Pump under the classification of Dynamic Pump namely Horizontal and Centrifugal Pumps. (4 Marks)

(6 marks)

- (b) i. A simplified and also fully labeled diagram needs to be sketched 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 content is to be discharged whenever the Level already exceed the Maximum Allowable Level. (6 Marks)
- ii. Using Diagram in (i.) as reference, you are required to identify the location to include two Pumps in the Diagram. Justify your answer. (3 Marks)
- iii. Based from your answer in (ii.), you are required to give examples of the most possible types of Pump to be utilized in the already sketched Diagram. (5 Marks)

(14 marks)

Question 2

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) The factors that strongly influence Selection of Valves come in the form of Service Conditions, Intended Tasks and Load Characteristics of Application. You are required to give explanation briefly all these factors. .

(6 marks)

- (b) i. A simplified sketch and fully labeled diagram need to be produced 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. By referring to Diagram in (i.), identify the intended task for those Valve being selected either On-Off or Regulating Valve. Justify your answer. (3 Marks)
- iii. Based from your answer in (ii.), list down examples of specific type of Valve that are worth to be utilized. (5 Marks)

(14 marks)

Question 3

In Process Control, it is very important to have the knowledge of the different types of Controller that consist of different combination settings of Proportional Band (PB) or sometimes the term Controller Gain being used instead, Integral Time (TI) and Derivative Time (TD). With the combination of these three elements that form inside one particular settings which can be labelled as different Trials can result in Powerful Controller Set of Tunings. From here, the next obvious step is to determine the most suitable Control Approach or better known as Control Strategy in order to cater the need of maintaining as well as controlling any process in order to meet the desired Production or volume of product while at the same time also being capable of meeting the required Product Specification.

- (a)
- i. You are being put to task of your Process Control Technical Supervisor to come out with a simplified Diagram for *Temperature Control System*. This Diagram should include relevant Instrumentation, suitable Controller as well as useful Final Control Element (FCE). (5 Marks)
 - ii. From your Diagram already produced in (i.), you are required to transform into Block Diagram that is so much related with Process Control.(4 Marks)
 - iii. Based from your Block Diagram in (ii.), give decision which indicates that you have already determine the correct Trials or combination of Controller Settings. (1 Mark)

(10 marks)

- (b)
- i. You are required to analyze a Boiler System by producing a simplified Diagram of a Boiler System or Steam Generator that utilize the Incoming Feed water as its source of producing Steam. (4 Marks)
 - ii. Based from the already produced Diagram in (i.) suggest TWO possible Control Strategies that can be implemented.(2 Marks)
 - iii. Finally, from your answer in (ii.) re-produce the Diagram in (i.) once again but this time include only one Control Strategy. (4 Marks)

(10 marks)

Question 4

Proportional Band (PB), Integral Time (TI) and Derivative Time (TD) or simply known as PID can be considered as three Parameters that are being used as Controller Setting. For any Process, it is essentially important to obtain the best combination of PID Parameters in order to meet the required Target Value or also known as Setting Point Value. For that matter, it is to be considered as successful if the Process Variable managed to reach the Setting Point Value and stays there for the longest time possible before the Setting Point Value needs to be changed according to the new setting in accordance with Product Specification as required by Top Management and also from the Clients or Customers. If this happens, then the process of finding the best combination of PID needs to start once again. This is where the PID Tuning becomes important in any Process Control.

- (a)
- i. If you need to perform PID Tuning to your respective Processing Plant, briefly explain the possible outcome that you hope to achieve at the end of this Tuning Activity. (4 Marks)
 - ii. Before the activity of PID Tuning is to be performed, you need to know important Key Points first. Describe briefly one of the Key Points. (2 Marks)
 - iii. Finally, before the process of PID Tuning takes place, it is essentially important to know all the three Parameters that are importantly useful in describing or indicating Process Characteristics. List down all those three Parameters. (3 Marks)

(9 marks)

- (b)
- Analyze the following Figure concerning Result for Experiment#2: Air/Gas Pressure Process Control and answer the following questions.
- i. By referring to Figure 1, give your comment in brief of the given result. (3 Marks)
 - ii. Discuss in brief the most likely Response when the experiment is to be repeated this time with Single Capacity Process and still under Trial 1. (3 Marks)
 - iii. While performing the experiment, you are required to use Bigger Proportional Band (PB) and also Bigger Integral Time (TI). Briefly discuss the possible Response that you will obtain. (4 Marks)
 - iv. Based from Figure 1, identify the classification of the Characteristic Of The Process. (1 Mark)

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

(11 marks)

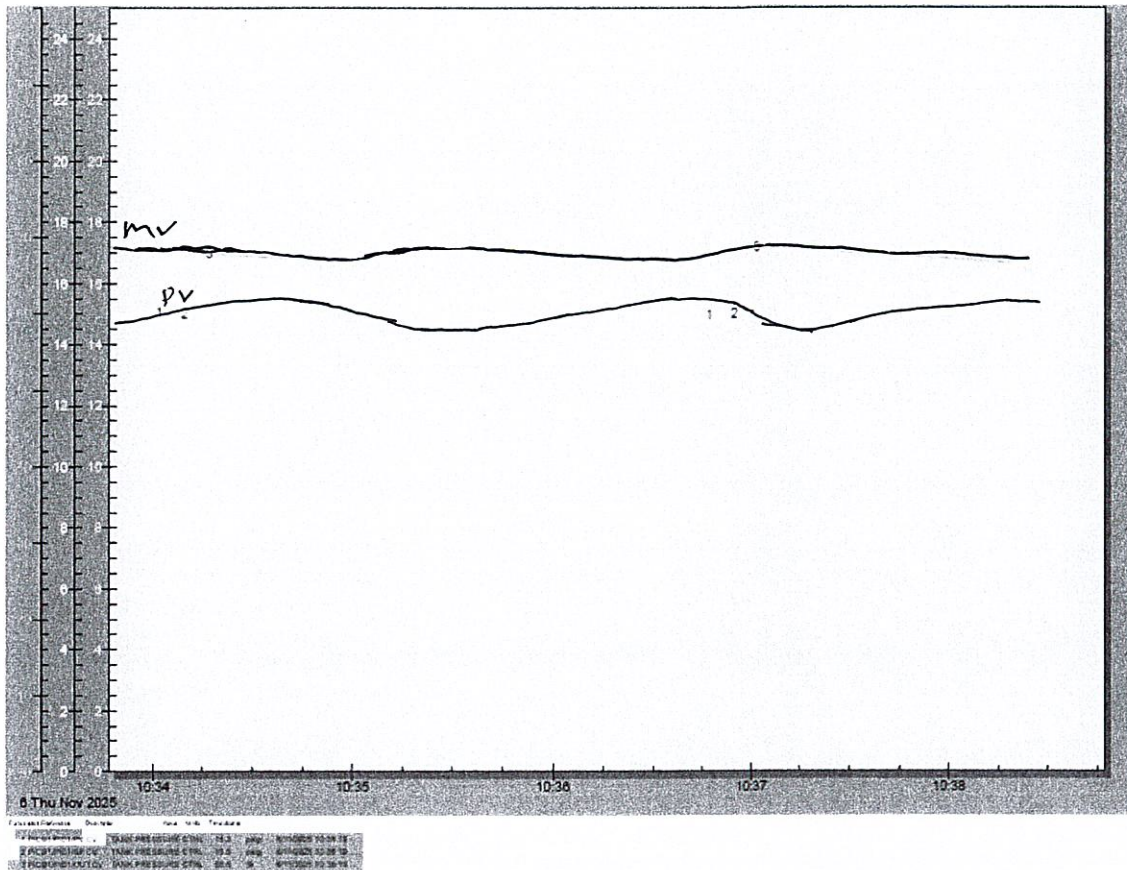


Figure 1: Response Of Trial 1 Double Capacity Process

END OF EXAMINATION PAPER

