



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

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CPD22103
COURSE TITLE : PROCESS INSTRUMENTATION & CONTROL
PROGRAMME NAME : DIPLOMA IN CHEMICAL ENGINEERING TECHNOLOGY
DATE : 31 JANUARY 2026
TIME : 9:00AM - 12:00PM
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. Section A consist 25 MCQ or EMQ questions. Answer ALL questions.
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 12 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 25 marks)

Answer ALL questions.

Please use the objective answer sheet provided.

1. A flow nozzle and an orifice plate are compared for the same flow condition. Compared to an orifice plate, a flow nozzle generally produces
 - A. Lower permanent pressure loss
 - B. No pressure loss
 - C. Higher permanent pressure loss
 - D. Unstable pressure readings

2. A selector control system selects the minimum signal among multiple controllers to protect equipment. This approach is commonly applied for
 - A. Energy optimization
 - B. Safety protection
 - C. Sensor calibration
 - D. Product quality improvement

3. A fluid moves through a pipe at a steady rate. The quantity of fluid passing a cross-section per unit time is required for process monitoring. This quantity represents the concept of
 - A. Flow
 - B. Density
 - C. Velocity
 - D. Pressure

4. During a plant upset, a high-level alarm (LAH) is triggered on a distillation column's reflux drum. The main purpose of this alarm within the process communication system is
- A. To record the event for the monthly production report.
 - B. To inform the operator that a critical limit is approaching so they can take corrective action.
 - C. To automatically shut down the entire plant.
 - D. To immediately open a safety valve and dump the inventory
5. A Venturi tube is installed in a horizontal pipeline carrying incompressible fluid. The fluid velocity increases at the throat section. The pressure at the throat section is
- A. Equal to the inlet pressure
 - B. Lower than at the inlet section
 - C. Independent of velocity change
 - D. Higher than at the inlet section
6. The goal of instrumentation and control in a production process is to
- A. Eliminate sensors
 - B. Reduce system automation
 - C. Maintain safe, efficient, and consistent operation
 - D. Make the process slower
7. A flow nozzle is installed in a pipeline to measure liquid flow. A differential pressure is detected between the upstream section and the nozzle throat. The flow rate through the nozzle is proportional to the
- A. Fluid viscosity only
 - B. Pressure difference
 - C. Square root of the pressure difference
 - D. Square of the pressure difference

8. A pressure control loop adjusts a control valve to maintain a set pressure. The valve acts as a
- A. Controller
 - B. Sensor
 - C. Final Control Element (FCE)
 - D. Process Variable
9. A flow meter is selected without considering fluid properties, resulting in inaccurate reading.
This situation highlights the importance of
- A. Unit standardization
 - B. Signal amplification
 - C. Electrical grounding
 - D. Proper flow meter selection
10. A temperature measurement system requires frequent sensor replacement without shutting down the process.
The use of a thermo-well provides this advantage by allowing
- A. Higher measurement accuracy
 - B. Faster temperature response
 - C. Removal of the sensor while the process is running
 - D. Direct exposure of the sensor to fluid
11. Select the best statement to describe the relationship between instrumentation and control
- A. Control measures and instrumentation adjust
 - B. Instrumentation provides measurement; control uses it for action
 - C. Instrumentation and control are identical
 - D. Control is independent of instrumentation

12. A household air-conditioning system adjusts cooling output based on room temperature readings.
In this everyday system, the temperature sensor functions as the
- A. Disturbance
 - B. Process
 - C. Measuring element
 - D. Final control element
13. A temperature sensor produces a voltage output when two dissimilar metals are joined and exposed to a temperature difference.
This device operates based on the
- A. Change in electrical resistance
 - B. Heat conduction
 - C. Seebeck effect
 - D. Thermal expansion
14. A level transmitter (LT) on a feed tank sends a 4-20 mA signal to the control system. If the control system reads a 20-mA signal, this most likely indicates the tank level
- A. The transmitter has failed and needs calibration.
 - B. The tank is at the 0% level (empty).
 - C. The tank is at the 100% level (full).
 - D. The tank is at the 50% level.
15. A feedback control system continuously compares the measured output with the desired value.
This comparison is used to
- A. Generate corrective control action
 - B. Fix the manipulated variable
 - C. Remove the need for sensors
 - D. Predict future disturbances

16. A pressure transmitter is mounted below the process tapping point. During calibration, the correction must be made by
- A. Reduce the span of the transmitter
 - B. Subtract the hydrostatic head pressure from the upper range value
 - C. Zero adjustment is not needed
 - D. Add the hydrostatic head pressure to the lower range value
17. A flow meter selection is required for measuring viscous fluid flow at low velocity with high accuracy. The most appropriate flow meter classification is
- A. Turbine flow meter
 - B. Positive displacement flow meter
 - C. Differential pressure flow meter
 - D. Ultrasonic flow meter
18. Adaptive control differs from conventional PID control because it
- A. Uses only proportional action
 - B. Requires manual retuning
 - C. Modifies parameters automatically
 - D. Operates without feedback
19. An orifice plate and a Venturi tube are used separately to measure flow in the same pipeline under identical flow conditions. Compared to the Venturi tube, the orifice plate produces
- A. Identical pressure recovery
 - B. Higher permanent pressure loss
 - C. No pressure loss
 - D. Lower permanent pressure loss

20. A Pitot tube is used to measure airflow velocity in a duct. An increase in measured pressure difference is observed.
This indicates that the fluid velocity has
- A. Increased
 - B. Decreased
 - C. Become zero
 - D. Remained constant
21. A regular inspection schedule is applied to a flow measurement system to prevent drifting and blockage.
This practice is categorized as follows
- A. Flow measurement principal
 - B. Flow unit conversion
 - C. Troubleshooting and maintenance
 - D. Flow meter classification
22. A platinum RTD is installed on a process line. An increase in process temperature causes an increase in electrical resistance.
This behavior indicates that the RTD operates based on
- A. Thermal radiation
 - B. Resistance–temperature relationship
 - C. Electromagnetic induction
 - D. Mechanical deformation
23. The controller in a control system receives a signal from the transmitter and sends a command to a valve. This action is described as
- A. Manual control
 - B. Feedback control
 - C. Calibration process
 - D. Direct measurement

24. A temperature sensor shows slower response compared to another sensor of the same type installed directly in the fluid.
This behavior is most likely caused by the presence of a
- A. Thermo-well
 - B. Signal conditioner
 - C. Calibration circuit
 - D. Transmitter
25. In a cascade system, faster disturbance rejection is achieved mainly due to
- A. Manual tuning of the primary controller
 - B. Increased proportional gain only
 - C. Direct correction by the secondary loop
 - D. Removal of feedback measurement

SECTION B (Total: 75 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Answer all questions.

- (a) A production process operates normally during steady-state conditions. Control disturbances appear during initial startup, system handover, and after recent modifications. Several faults match previous operating records, while other disturbances display unfamiliar behavior.
- i. Classify **FIVE (5)** process control problems present in the situation.
(5 marks)
 - ii. Explain of each identified process control problem as Item (i) is associated with the operating condition.
(5 marks)
- (b) Feedback control and feedforward control represent two common strategies applied in process control systems.
- i. Differentiate feedback control and feedforward control based on operating principle.
(6 marks)
 - ii. Compare feedback control and feedforward control in terms of control function.
(4 marks)
- (c) During plant operation, several control loops show unstable performance. The temperature in a heating system fluctuates, flow rate in a pipeline cannot be maintained, pressure in a vessel rises beyond the set range, liquid level in a tank becomes inconsistent, and motor speed varies unexpectedly.

- i. From the situation, identify **FIVE (5)** suitable final control elements involved.

(5 marks)

Question 2

Answer all questions.

- (a) Troubleshooting is an essential process in identifying and resolving problems in engineering and industrial systems.

- i. Explain **FOUR (4)** key steps involved in the troubleshooting process.

(8 marks)

- ii. Identify **ONE (1)** fundamental troubleshooting rule and describe its importance.

(2 marks)

- (b) During operation of an industrial heating system, temperature readings become unreliable. Sudden fluctuations are observed at high temperature, small temperature changes are not detected accurately, and non-contact measurement is required at certain points.

- i. From the situation, select **FIVE (5)** appropriate temperature measurement devices.

(5 marks)

- ii. Explain the suitability of each device as Item (i) under the given operating condition.

(5 marks)

- (c) A process control system experiences repeated flow instability despite stable operating settings. Sensor readings appear inconsistent, valve response is sluggish, and coordination between operators and engineers is limited during troubleshooting activities.

- i. Identify **FIVE (5)** key elements required of an engineering technologist acting as an effective process troubleshooter to the observed system behavior.

(5 marks)

Question 3

Answer all questions.

- (a) An industrial manufacturing system experiences inconsistent product output, repeated safety alerts, rising operating costs, environmental non-compliance warnings, and frequent unplanned shutdowns. Manual corrective actions fail to maintain stable operation over extended production periods.
- i. Based on the situation provided, identify **FIVE (5)** critical aspects in industrial operations.
(5 marks)
- ii. Describe the impact of each identified aspect as Item (i) on the operational condition.
(5 marks)
- (b) During continuous plant operation, unstable flow readings are recorded in a production line. The process experiences fluctuating output, inconsistent product quality, and repeated safety alarms. Variations in fluid properties, pipe conditions, and operating temperature are observed throughout the system.
- i. From the situation, identify **FIVE (5)** effects of inaccurate flow measurement.
(5 marks)
- ii. Explain each identified effect in Item (i) linked to the operational condition.
(5 marks)
- (c) A chemical processing plant experiences frequent temperature fluctuations, inconsistent product quality, increased energy consumption, and several near-miss safety incidents. Manual adjustments are commonly applied during operation, resulting in unstable process conditions.
- i. Identify **FIVE (5)** areas of process control importance observed in the situation.
(5 marks)

Question 4

Answer all questions.

- (a) A liquid flow control system in a chemical processing line shows repeated fluctuations around the desired set point. The control screen displays unstable readings, and product quality begins to vary. Initial observation indicates no alarm signals, but operators report inconsistent valve movement during operation.

Analyze the situation by:

- i. Outline **FIVE (5)** systematic steps involved in the troubleshooting process.
(5 marks)

- ii. Explain the role of each step in Item (i) resolves the problem and prevent from recurrence.
(5 marks)

- (b) A temperature control system receives correct signals from the controller, yet the process temperature remains unchanged. System indicators show normal sensor readings and stable controller output.

- i. Identifying the role of the final control element in this situation.
(5 marks)

- (c) During operation of an automated industrial process, unstable output is observed. Sensor readings fluctuate, displayed values do not reflect actual process conditions, and control actions fail to maintain the desired operating state.

- i. Define the terms instrument, measurement, and control as applied in the given situation.
(6 marks)

- ii. Explain the link between instrument-measurement relationship and measurement-control relationship in the operational fault.
(4 marks)

END OF EXAMINATION PAPER

