

UNIT – I SIMPLE PROCESS CONTROL SYSTEMS AND TERMINOLOGY

1. Which control strategy is most common in continuous processes?
A) Open-loop control
B) Feedback control
C) Manual control
D) Sequential control only

Answer: B

2. In a batch process, process variables often:
A) Remain constant
B) Change with time during each batch
C) Are never measured
D) Do not affect quality

Answer: B

3. Which instrument is commonly used to measure process variables in both continuous and batch processes?
A) Process transmitter
B) Thermometer only
C) Hand tools
D) Mechanical switch only

Answer: A

4. Which instrument directly senses the process variable to produce the measured value?
A) Control valve
B) PLC
C) Sensor
D) Final control element

Answer: C

5. In process instrumentation, the measured value is usually transmitted as:
A) 4–20 mA or a digital signal
B) 100–200 V
C) 230 V AC only
D) Mechanical motion only

Answer: A

6. Which process variable is controlled in a liquid level control system?
A) Pressure
B) Temperature
C) Liquid level
D) Flow rate

Answer: C

7. Which final control element is commonly used in a flow control loop?
A) Control Valve
B) Thermostat

- C) Relay
- D) Ammeter

Answer: A

8. Which controller is most widely used for temperature control?
- A) ON–OFF controller
 - B) PID controller
 - C) Relay controller
 - D) Timer controller

Answer: B

9. Transportation lag occurs between
- A) Disturbance and process response
 - B) Controller and power supply
 - C) Sensor and indicator only
 - D) Motor and gearbox only

Answer: A

10. In a self-regulating process, after a disturbance the process variable:
- A) Increases indefinitely
 - B) Decreases indefinitely
 - C) Settles at a new steady-state value
 - D) Oscillates forever

Answer: C

11. A self-regulating process has:
- A) No steady state
 - B) A stable operating point
 - C) Infinite gain
 - D) Zero process variable

Answer: B

12. The primary purpose of a P&ID is to:
- A) Show the building layout
 - B) Show process equipment, piping, instruments, and control loops
 - C) Display electrical wiring only
 - D) Show the factory location

Answer: B

13. The arrow on a process line in a P&ID indicates
- A) Pipe material
 - B) Flow direction
 - C) Pipe size
 - D) Pressure rating

Answer: B

14. The second letter I in an instrument tag (e.g., FI, PI) indicates:
- A) Indicator
 - B) Integrator
 - C) Input

D) Isolator

Answer: A

15. Which process generally offers higher production rates?

- A) Batch process
- B) Continuous process
- C) Manual process
- D) Job-shop process

Answer: B

16. The measured value is also called the:

- A) Process feedback signal
- B) Set point
- C) Manipulated variable
- D) Disturbance

Answer: A

17. Which process variable is manipulated to control liquid level?

- A) Inlet or outlet flow rate
- B) Tank color
- C) Pipe diameter
- D) Ambient temperature

Answer: A

18. The difference between the set point and the measured level is called:

- A) Span
- B) Range
- C) Hysteresis
- D) Error

Answer: D

19. Which of the following is NOT a flow measuring instrument?

- A) Venturi tube
- B) Rotameter
- C) Electromagnetic flow meter
- D) Thermocouple

Answer: D

20. Which of the following can act as a disturbance in a temperature control system?

- A) Change in ambient temperature
- B) Tank color
- C) Pipe length
- D) Cable size

Answer: A

21. Transportation lag causes:

- A) Immediate process response
- B) Delayed process response
- C) Increased flow rate
- D) Reduced sensor accuracy

Answer: B

ANALYTICAL QUESTIONS

1. A chemical reactor operates continuously with raw materials entering and products leaving at the same time. This system is classified as:
- A) Batch process
 - B) Continuous process
 - C) Manual process
 - D) Sequential process

Answer: B

2. A level controller is designed to maintain a tank level at 50%. The desired 50% level represents:
- A) Measured value
 - B) Error signal
 - C) Set point
 - D) Manipulated variable

Answer: C

3. If the set point of a tank level is 5 m and the measured level is 4.6 m, the error is:
- A) 0.4m
 - B) -0.4m
 - C) 9.6m
 - D) 5.4m

Answer: A

4. In a flow control system, if the flow transmitter senses lower flow than the set point, the controller should:
- A) Close the control valve further
 - B) Open the control valve
 - C) Stop the pump
 - D) Reduce transmitter sensitivity

Answer: B

5. A process returns naturally to a new equilibrium after a disturbance without controller action. This property is called:
- A) Stability
 - B) Transportation lag
 - C) Self-regulation
 - D) Oscillation

Answer: C

6. In the functional block diagram of an automatic process control system, the correct sequence is:
- A) Process → Controller → Sensor → Valve
 - B) Set Point → Comparator → Controller → Final Control Element → Process
 - C) Sensor → Controller → Comparator → Process
 - D) Process → Controller → Comparator → Sensor

Answer: B

7. A temperature sensor is placed far from the heater. Which is the most likely

consequence?

- A) Reduced error
- B) Increased transportation lag
- C) Faster control action
- D) Elimination of disturbances

Answer: B

8. In a simple liquid level control system, if the level transmitter fails and always indicates the correct level regardless of the actual tank level, the controller will most likely:
- A) Operate normally
 - B) Increase inlet flow automatically
 - C) Fail to correct actual level changes
 - D) Reduce outlet flow automatically

Answer: C

9. A control valve shown in a P&ID is mainly used to:
- A) Measure pressure
 - B) Store liquid
 - C) Generate electrical signals
 - D) Control process variables by regulating flow

Answer: D

UNIT – II CONTROL PRINCIPLES

1. Which of the following describes the relationship between the controller output and the error signal?
- A) Proportional Band
 - B) Reverse and direct action
 - C) Differential gap
 - D) Pneumatic relay

Answer: B

2. Which controller mode is classified as "discontinuous"?
- A) Proportional (P)
 - B) Integral (I)
 - C) ON-OFF Control
 - D) Derivative (D)

Answer: C

3. In ON-OFF control, what is used to prevent the controller from switching too frequently?
- A) Differential gap
 - B) Proportional band
 - C) Error detector
 - D) Flapper nozzle

Answer: A

4. Which parameter is specific to a proportional (P) controller?
- A) Pneumatic relay

- B) Proportional Band (PB)
- C) Derivative time
- D) Reset rate

Answer: B

5. What is the common term for the steady-state error that remains when using only a proportional controller?
- A) Differential gap
 - B) Offset
 - C) Lag
 - D) Error detection

Answer: B

6. Which control action is explicitly listed as a "continuous" mode?
- A) Proportional controller
 - B) Two-position controller
 - C) ON-OFF without differential gap
 - D) Pneumatic relay

Answer: A

7. The "effect of PB" in a proportional controller is primarily observed on the:
- A) Setpoint
 - B) Controller output
 - C) Error detector
 - D) Flapper nozzle

Answer: B

8. Which control mode is specifically focused on the "rate" of change of the error?
- A) Integral control
 - B) Derivative control
 - C) ON-OFF control
 - D) Two-position control

Answer: B

9. A controller that combines proportional and integral actions is known as a:
- A) PI controller
 - B) PD controller
 - C) PID controller
 - D) Two-position controller

Answer: A

10. A controller that combines proportional and derivative actions is known as a:
- A) PI controller
 - B) PD controller
 - C) PID controller
 - D) ON-OFF controller

Answer: B

11. Which mode represents the most comprehensive form of continuous control listed?

- A) PI
- B) PD
- C) PID
- D) ON-OFF

Answer: C

12. In an electronic controller, what component is responsible for comparing the setpoint and the measured variable?
- A) Error detector
 - B) Pneumatic relay
 - C) Flapper nozzle
 - D) Proportional band

Answer: A

13. A "two-position controller" is essentially another term for which mode?
- A) Proportional control
 - B) ON-OFF control
 - C) PID control
 - D) Integral control

Answer: B

14. Which mechanism is a fundamental part of a pneumatic PID controller?
- A) Flapper nozzle mechanism
 - B) Electronic error detector
 - C) Digital microprocessor
 - D) Differential gap sensor

Answer: A

15. What is the purpose of a "pneumatic relay" in a pneumatic controller?
- A) To eliminate offset
 - B) To provide power/signal amplification
 - C) To calculate the derivative action
 - D) To adjust the proportional band

Answer: B

16. When choosing between P, PI, or PID actions, the process is referred to as:
- A) Selection of control action
 - B) Differential gap adjustment
 - C) Direct action calibration
 - D) Offset elimination

Answer: A

17. Which of the following is NOT a continuous controller mode?
- A) Proportional
 - B) Integral
 - C) Two-position
 - D) Derivative

Answer: C

18. The source lists "salient features, applications, and limitations" for which group of

controllers?

- A) Only ON-OFF controllers
- B) Only pneumatic controllers
- C) PI, PD, and PID controllers
- D) Only error detectors

Answer: C

19. If a controller's output increases as the measurement increases, it is using:
- A) Reverse action
 - B) Direct action
 - C) Integral action
 - D) Derivative action

Answer: B

20. Which type of controller can be implemented using both electronic and pneumatic technology?
- A) PID controller
 - B) Only ON-OFF controller
 - C) Only two-position controller
 - D) Only proportional band controller

Answer: A

21. The Proportional Band (PB) is inversely related to the "gain" of which controller?
- A) Proportional (P) controller
 - B) Integral (I) controller
 - C) Derivative (D) controller
 - D) ON-OFF controller

Answer: A

ANALYTICAL QUESTIONS

1. A process requires the controller to decrease its output as the measurement increases above the setpoint. Which controller action must be selected to achieve this?
- A) Direct action
 - B) Reverse action
 - C) Differential gap action
 - D) Integral action

Answer: B

2. In an ON-OFF control system, what is the primary consequence of removing the "differential gap"?
- A) The controller will eliminate all offset
 - B) The final control element will experience rapid cycling and increased wear
 - C) The controller becomes a continuous proportional controller
 - D) The proportional band becomes infinite

Answer: B

3. If an operator widens the Proportional Band (PB) on a controller, what is the most likely effect on the system's stability and response?

- A) The controller becomes more sensitive, increasing the risk of oscillation
- B) The "offset" is completely eliminated
- C) The controller becomes less sensitive, likely resulting in a slower response and a larger offset
- D) The derivative time (D) automatically increases to compensate

Answer: C

4. Why is a Proportional (P) controller often insufficient for processes requiring high precision over long periods?
- A) It is a discontinuous mode
 - B) It inherently results in a steady-state "offset" that it cannot eliminate alone
 - C) It cannot be implemented in electronic controllers
 - D) It only works with a flapper nozzle mechanism

Answer: B

5. Which control action is specifically designed to eliminate the "offset" caused by proportional-only control?
- A) Derivative control
 - B) Integral control
 - C) Two-position control
 - D) Direct action

Answer: B

6. A derivative (D) control action is often described as "anticipatory." How does this feature affect the "selection of control action" for a process with significant noise?
- A) It makes the controller ignore the noise entirely
 - B) It is the ideal choice because it reacts to the rate of change of noise
 - C) It may be limited because it can amplify noise, leading to unstable controller output
 - D) It forces the controller into ON-OFF mode

Answer: C

7. In a pneumatic PID controller, what is the mechanical relationship between the "flapper nozzle mechanism" and the "pneumatic relay"?
- A) They are identical components
 - B) The relay detects the error and the flapper nozzle amplifies it
 - C) The flapper nozzle detects small changes in the error signal, while the relay provides power amplification for the output
 - D) The relay eliminates the differential gap of the flapper nozzle

Answer: C

8. When comparing electronic and pneumatic controllers, what is the fundamental role of the "error detector"?
- A) To adjust the proportional band (PB)
 - B) To determine the difference between the setpoint and the measured variable
 - C) To eliminate the need for a pneumatic relay
 - D) To convert continuous signals into discontinuous ON-OFF signals

Answer: B

9. Which controller configuration would be most appropriate for a complex process that requires zero steady-state error and a rapid response to sudden load

changes?

- A) Proportional (P) only
- B) Proportional-Integral (PI)
- C) Proportional-Integral-Derivative (PID)
- D) Two-position controller

Answer: C

UNIT – III TUNING OF CONTROLLERS AND FINAL CONTROL ELEMENTS

1. Which integral error criterion is most effective for penalizing errors that persist for a long duration in a control system?
 - A) Quarter Decay Ratio
 - B) ITAE
 - C) ISE
 - D) IAE

Answer: B

2. The primary objective of controller tuning is to:
 - A) Increase process pressure
 - B) Obtain the desired dynamic response of the control system
 - C) Reduce valve size
 - D) Increase sensor sensitivity

Answer: B

3. ISE stands for:
 - A) Integral of Square Error
 - B) Integral of Simple Error
 - C) Initial Square Error
 - D) Integrated Signal Error

Answer: A

4. ITAE is preferred because it:
 - A) Ignores large errors
 - B) Penalizes errors that persist for a long time
 - C) Eliminates overshoot completely
 - D) Works only for ON-OFF controller

Answer: B

5. A Quarter Decay Ratio means:
 - A) Each successive oscillation has one-fourth the amplitude of the previous one
 - B) Oscillations remain constant
 - C) No oscillations occur
 - D) Amplitude doubles every cycle

Answer: A

6. Which controller tuning method uses the process reaction curve
 - A) Ultimate cycle method
 - B) Closed-loop tuning
 - C) Open-loop tuning
 - D) Damped oscillation method

Answer: C

7. In the open-loop tuning method, the controller is usually kept in:
- A) Automatic mode
 - B) Cascade mode
 - C) Manual mode
 - D) Ratio mode

Answer: C

8. The process reaction curve is obtained by applying:
- A) Sinusoidal input
 - B) Step input
 - C) Ramp input
 - D) Pulse input

Answer: B

9. The ultimate cycle method is also known as:
- A) Cohen-Coon method
 - B) Lambda tuning
 - C) Relay tuning
 - D) Ziegler-Nichols closed-loop method

Answer: D

10. The ultimate gain (K_u) is:
- A) Minimum controller gain
 - B) Gain at which sustained oscillations occur
 - C) Maximum valve gain
 - D) Gain at zero error

Answer: B

11. In the ultimate cycle method, the oscillation period is called:
- A) Dead time
 - B) Rise time
 - C) Ultimate period (P_u)
 - D) Settling time

Answer: C

12. The damped oscillation method adjusts controller parameters until:
- A) Continuous oscillations occur
 - B) Oscillations disappear immediately
 - C) Oscillations decay gradually
 - D) Process becomes unstable

Answer: C

13. Which valve is mainly used for ON/OFF service and has very low pressure drop?
- A) Globe valve
 - B) Gate valve
 - C) Needle valve
 - D) Diaphragm valve

Answer: B

14. Which valve provides excellent throttling characteristics?

- A) Gate valve
- B) Globe valve
- C) Ball valve
- D) Plug valve

Answer: B

15. Which valve uses a rotating spherical ball with a hole through it

- A) Butterfly valve
- B) Globe valve
- C) Ball valve
- D) Knife valve

Answer: C

16. Butterfly valves are preferred because they are:

- A) Heavy and expensive
- B) Compact and lightweight
- C) Used only for steam
- D) Suitable only for high-pressure application

Answer: B

17. Knife gate valves are mainly used for

- A) Clean water
- B) Slurry and pulp applications
- C) High-pressure steam
- D) Vacuum system

Answer: B

18. Flashing in a control valve occurs when:

- A) Vapor bubbles form and collapse inside the valve
- B) Liquid permanently changes into vapor after pressure drops below vapor pressure
- C) Pressure increases suddenly
- D) Valve stem vibrate

Answer: B

19. Cavitation is caused by:

- A) Permanent vapor formation
- B) Valve leakage
- C) High valve temperature only
- D) Collapse of vapor bubbles after pressure recovery

Answer: D

20. A solenoid valve is operated by:

- A) Hydraulic pressure
- B) Manual lever
- C) Electromagnetic coil
- D) Pneumatic diaphragm

Answer: C

21. The function of an I/P converter is to convert:
- A) Current signal into pneumatic pressure
 - B) Pneumatic pressure into current
 - C) Voltage into current
 - D) Pressure into voltage

Answer: A

ANALYTICAL QUESTIONS

1. A control engineer needs to tune a loop where large initial errors are extremely detrimental to equipment safety, but small residual offsets are tolerable. Which integral error criterion should be prioritized to penalize large deviations most severely?
- A) IAE (Integral of Absolute Error)
 - B) ISE (Integral of Squared Error)
 - C) ITAE (Integral of Time-weighted Absolute Error)
 - D) Quarter Decay Ratio

Answer: B

2. You observe a process response where the first peak is 8 units from the setpoint and the second peak is 2 units from the setpoint. Which tuning objective does this response satisfy?
- A) Sustained Oscillation
 - B) Critical Damping
 - C) Quarter Decay Ratio
 - D) Over-damping

Answer: C

3. In a process where it is essential that the system settles at the setpoint quickly without long-term "drifting" errors, which criterion is most suitable for tuning?
- A) ITAE
 - B) ISE
 - C) Quarter Decay Ratio
 - D) IAE

Answer: A

4. A technician must tune a controller for a process that cannot be disconnected from the controller (the loop must remain closed) during testing. Which method is most appropriate?
- A) Process Reaction Curve
 - B) Open-loop response method
 - C) Ultimate Cycle Method
 - D) Manual Step Test

Answer: C

5. During the Ultimate Cycle Method, the proportional gain is increased until the system reaches "sustained oscillations." At this specific point, what is the stability state of the system?
- A) Absolute Stability
 - B) Marginal Stability

- C) Total Instability
- D) Critical Damping

Answer: B

6. A plant handles thick slurries and viscous fluids that frequently cause standard valves to seize or clog. Which valve design is specifically intended to "cut through" such media?
- A) Globe valve
 - B) Butterfly valve
 - C) Knife valve
 - D) Ball valve

Answer: C

7. During a high-pressure drop across a valve, the liquid pressure falls below the vapor pressure inside the valve, and the outlet pressure remains below the vapor pressure. This phenomenon is:
- A) Cavitation
 - B) Flashing
 - C) Throttling
 - D) Damping

Answer: B

8. A digital controller sends a 4-20mA electronic signal to a valve, but the valve actuator requires 3-15 psi air pressure to move. If the electronic signal is active but no air pressure is reaching the valve, which device is likely faulty?
- A) P to I converter
 - B) Positioner
 - C) I to P converter
 - D) Solenoid valve

Answer: C

9. A globe valve is used for precise throttling, but the control system struggles with friction and hysteresis, preventing the valve from reaching the exact requested position. Which accessory should be added to resolve this?
- A) Solenoid valve
 - B) I to P converter
 - C) Positioner
 - D) P to I converter

Answer: C

UNIT – IV COMPLEX AND DIGITAL CONTROL SYSTEMS

1. Which control strategy is specifically listed as being compared to the feedback control system?
- A) Ratio control
 - B) Feed forward control system
 - C) Cascade control
 - D) Direct digital control

Answer: B

2. According to the sources, feed forward control is applied to which process unit?
- A) Distillation column
 - B) Centrifuge
 - C) Heat exchanger
 - D) Compressor

Answer: C

3. Which control method is used to maintain a relationship between two or more process variables?
- A) Cascade control
 - B) Direct digital control
 - C) Ratio control
 - D) Feed forward control

Answer: C

4. Cascade control is applied to which of the following applications in the source text?
- A) Single loop digital control
 - B) Heat exchanger and distillation column
 - C) Ratio control examples
 - D) Feedback comparisons

Answer: B

5. What does the acronym "DDC" represent in the context of control loops?
- A) Digital Direct Command
 - B) Dual Data Circuit
 - C) Direct Digital Control
 - D) Distributed Device Control

Answer: C

6. The source mentions that Direct Digital Control (DDC) can be applied to:
- A) Only single loops
 - B) Only multiple loops
 - C) Both single loops and multiple control loops
 - D) Manual loops

Answer: C

7. Which strategy is explicitly mentioned as having "examples" to be studied?
- A) Ratio control
 - B) Cascade control
 - C) Feedback control
 - D) Feed forward control

Answer: A

8. In a comparison of control systems, which one typically acts before a disturbance affects the process output?
- A) Feedback control
 - B) Feed forward control
 - C) Manual control
 - D) DDC

Answer: B

9. Cascade control of a distillation column is used to manage:
- A) Only the feed rate
 - B) Complex interactions within the column
 - C) Digital signals only
 - D) Feedback comparison loops

Answer: B

10. A "multiple control loop" configuration is a variation of which system?
- A) Feed forward
 - B) Ratio control
 - C) Direct Digital Control (DDC)
 - D) Feedback control

Answer: C

11. Which application is common to both Feed Forward and Cascade control in the source list?
- A) Distillation column
 - B) Heat exchanger
 - C) Single loop DDC
 - D) Ratio control

Answer: B

12. Feedback control systems are primarily compared with which other system in the source?
- A) Ratio control
 - B) Direct digital control
 - C) Single loop DDC
 - D) Feed forward control system

Answer: D

13. Which control strategy is best suited for keeping a constant proportion between a wild flow and a controlled flow?
- A) Cascade control
 - B) Ratio control
 - C) DDC
 - D) Feedback control

Answer: B

14. Direct Digital Control (DDC) of a single loop implies that:
- A) A computer is directly responsible for the control action
 - B) No sensors are required
 - C) The system is entirely analog
 - D) Only ratio control is used

Answer: A

15. Cascade control of a heat exchanger typically involves:
- A) A single digital loop
 - B) Two nested loops (primary and secondary)

- C) A ratio of two temperatures
- D) Manual override only

Answer: B

16. What is the main advantage of feed forward control over feedback control?
- A) It is simpler to implement
 - B) It requires no measurement of the process
 - C) It can compensate for disturbances before the process is upset
 - D) It only works for heat exchangers

Answer: C

17. Which system is listed immediately after "Ratio control – examples" in the source?
- A) Feed forward control
 - B) Cascade control
 - C) DDC
 - D) Distillation column

Answer: B

18. In the source, how many different industrial units are specifically linked to cascade control?
- A) One (Heat exchanger)
 - B) Two (Heat exchanger and Distillation column)
 - C) Three (Heat exchanger, Distillation, and DDC)
 - D) None

Answer: B

19. Ratio control examples often involve:
- A) Blending two or more streams in a fixed proportion
 - B) Cooling a single stream
 - C) Managing a single digital loop
 - D) Comparing feedback to feed forward

Answer: A

20. Which control strategy is categorized under "DDC" in the source?
- A) Distillation column control
 - B) Heat exchanger control
 - C) Single loop and multiple control loops
 - D) Ratio control examples

Answer: C

21. Which system provides the "master/slave" architecture often found in complex processes like distillation?
- A) Feed forward control
 - B) Feedback control
 - C) Cascade control
 - D) Ratio control

Answer: C

ANALYTICAL QUESTIONS

1. Why would a feed forward control system be compared to a feedback control

system?

- A) To show that feedback is faster than feed forward
- B) To contrast a system that reacts to errors (feedback) with one that reacts to disturbances (feed forward)
- C) To prove that only feed forward can be used in heat exchangers
- D) To show that they cannot be used in the same process

Answer: B

2. In a ratio control application, what is the logical result if the "wild" (independent) flow decreases?
- A) The controlled flow must increase to compensate
 - B) The system automatically switches to cascade control
 - C) The controlled flow must decrease to maintain the set proportion
 - D) The setpoint for the wild flow changes

Answer: C

3. In a feed forward control system for a heat exchanger, which variable is normally measured to compensate for disturbances?
- A) Outlet temperature only
 - B) Steam pressure only
 - C) Disturbance such as inlet fluid temperature or flow rate
 - D) Ambient temperature only

Answer: C

4. In a blending process, the flow rate of one liquid must always be maintained at twice the flow rate of another liquid. Which control strategy should be used?
- A) Feedback control
 - B) Cascade control
 - C) Feed forward control
 - D) Ratio control

Answer: D

5. A cascade control system is used in a heat exchanger. The primary controller regulates outlet temperature, while the secondary controller regulates steam flow. What is the main advantage of this arrangement?
- A) It reduces the number of controllers
 - B) It corrects disturbances in the steam flow more quickly
 - C) It eliminates the need for sensors
 - D) It converts pneumatic signals into electrical signals

Answer: B

6. A Direct Digital Control (DDC) system is used to control the temperature of a single furnace. Which device performs the control calculations?
- A) Pneumatic relay
 - B) Analog controller
 - C) Digital computer or microprocessor
 - D) Pressure transmitter

Answer: C

7. In a distillation column using cascade control, the primary controller measures

product composition and sends its output to a secondary controller that controls steam flow. Why is cascade control preferred?

- A) It reduces installation cost
- B) It responds faster to disturbances affecting steam flow
- C) It removes the need for a reboiler
- D) It replaces the temperature sensor

Answer: B

8. A manufacturing plant uses one computer to control the temperature, pressure, and flow of different processes simultaneously. This is an example of:

- A) Single-loop DDC
- B) Feed forward control
- C) Multi-loop Direct Digital Control
- D) Ratio control

Answer: C

9. A factory wants to improve product quality by correcting disturbances before they affect the process while also eliminating any remaining error. Which combination of control systems provides the best performance?

- A) Feed forward control only
- B) Feedback control only
- C) Feed forward and feedback control together
- D) Ratio control only

Answer: C

UNIT – V PLC AND DISTRIBUTED CONTROL SYSTEMS

1. A factory wants to replace relay-based control with a system that can be easily reprogrammed when the production process changes. Which device is most suitable?

- A) Analog controller
- B) PLC
- C) Pressure transmitter
- D) Control valve

Answer: B

2. Which component of a PLC scans input signals, executes the program, and updates the outputs?

- A) Input module
- B) Output module
- C) CPU
- D) Power supply

Answer: C

3. In a PLC, the main function of the input module is to:

- A) Drive actuators
- B) Store programs
- C) Receive signals from field devices
- D) Display process variables

Answer: C

4. A PLC repeatedly performs the sequence of reading inputs, executing the program, and updating outputs. This operation is known as:
- A) Data conversion
 - B) Scan cycle
 - C) Signal conditioning
 - D) Communication cycle

Answer: B

5. In a PLC, the CPU performs which operation first in the scan cycle?
- A) Update outputs
 - B) Execute program
 - C) Read inputs
 - D) Restart system

Answer: C

6. PLCs are mainly used in:
- A) Home entertainment systems
 - B) Industrial process automation
 - C) Mobile phones
 - D) Satellite communication

Answer: B

7. Ladder Logic is designed to resemble:
- A) Electrical relay circuits
 - B) Flowcharts
 - C) C programming
 - D) Circuit diagrams of microprocessors

Answer: A

8. Which of the following is a major advantage of a PLC over relay logic?
- A) More mechanical parts
 - B) Difficult troubleshooting
 - C) Easy modification through software
 - D) Requires frequent rewiring

Answer: C

9. Which application is most suitable for a PLC?
- A) Domestic water heater
 - B) Conveyor belt automation
 - C) Manual valve operation
 - D) Mechanical gearbox

Answer: B

10. In a Distributed Control System (DCS), the control functions are:
- A) Performed only by one central controller
 - B) Distributed among several controllers
 - C) Performed manually
 - D) Controlled only by PLCs

Answer: B

11. The main advantage of distributing controllers in a DCS is:
- A) Increased wiring complexity
 - B) Elimination of communication networks
 - C) Improved reliability and reduced failure impact
 - D) Higher power consumption

Answer: C

12. Which component of a DCS allows the operator to monitor and control the process?
- A) Sensor
 - B) Human-Machine Interface (HMI) or Operator Station
 - C) Relay
 - D) Solenoid valve

Answer: B

13. A petroleum refinery has hundreds of control loops spread across different process units. Which control system is most suitable?
- A) DCS
 - B) Relay control
 - C) On-off controller
 - D) Manual control

Answer: A

14. Compared to a PLC, a DCS is generally preferred for:
- A) Single machine automation
 - B) Large continuous process industries
 - C) Home automation
 - D) Traffic signal control

Answer: B

15. Which of the following is an advantage of a DCS?
- A) Centralized failure stops the entire plant
 - B) Better monitoring and control of large processes
 - C) Cannot communicate with field devices
 - D) Requires only manual operation

Answer: B

16. Which communication protocol is specifically designed for industrial field devices and supports distributed control?
- A) USB
 - B) Bluetooth
 - C) HDMI
 - D) Fieldbus

Answer: D

17. PROFIBUS is mainly used for:
- A) Video transmission
 - B) Industrial field communication

- C) Audio streaming
- D) Email communication

Answer: B

18. HART protocol allows:
- A) Digital communication over analog 4–20 mA signals
 - B) Wireless internet access
 - C) Video conferencing
 - D) Bluetooth communication

Answer: A

19. Which protocol is known as an open serial communication protocol?
- A) Modbus
 - B) USB
 - C) HDMI
 - D) Ethernet/IP

Answer: A

20. Which communication protocol combines digital signals with existing analog wiring?
- A. PROFIBUS
 - B. HART
 - C. CAN
 - D. DeviceNet

Answer: B

21. Which communication protocol is commonly used with smart transmitters?
- A. HART
 - B. SMTP
 - C. FTP
 - D. POP3

Answer: A

ANALYTICAL QUESTIONS

1. A technician writes a PLC program using symbols that resemble electrical relay circuits. Which programming language is being used?
- A) C Language
 - B) Assembly Language
 - C) Python
 - D) Ladder Logic

Answer: D

2. A motor should start only when both the Start button is pressed and the safety switch is ON. In ladder logic, these two inputs are connected:
- A) In parallel
 - B) In series
 - C) Across the output coil
 - D) Through a timer

Answer: B

3. A conveyor motor should start if either Switch A or Switch B is pressed. In ladder logic, the contacts should be connected:
- A) In parallel
 - B) In series
 - C) Across the power supply
 - D) Through a counter

Answer: A

4. A refinery requires continuous monitoring and control of hundreds of process variables across different plant sections. Which system provides the most suitable solution?
- A) A single PLC with no networking
 - B) DCS with distributed controllers
 - C) Manual control panels
 - D) Standalone PID controller

Answer: B

5. A company plans to automate a bottling line consisting of filling, capping, and labeling machines operating independently. Which control system is generally more suitable?
- A) DCS, because it is designed for discrete machine control
 - B) PLC, because it efficiently handles sequential machine operations
 - C) HART, because it controls all machines directly
 - D) Modbus, because it replaces controllers

Answer: B

6. A technician needs to calibrate a smart pressure transmitter while it continues sending its normal 4–20 mA process signal to the control system. Which protocol allows this?
- A) PROFIBUS DP
 - B) Ethernet
 - C) HART
 - D) CAN Bus

Answer: C

7. An engineer wants to connect multiple PLCs and HMIs from different manufacturers using a simple, open communication protocol. Which protocol is the best choice?
- A) HART
 - B) Modbus
 - C) PROFIBUS PA
 - D) USB

Answer: B

8. One controller in a DCS network fails, but the remaining sections of the plant continue operating normally. Which feature of DCS is demonstrated?
- A) Centralized processing
 - B) Single-point failure
 - C) Sequential programming

D) Distributed architecture with improved reliability

Answer: D

9. A ladder logic program contains a normally open start push button and a normally closed stop push button with a seal-in (holding) contact. After pressing the Start button and releasing it, the motor continues to run until the Stop button is pressed. Why?
- A) The timer keeps the motor energized.
 - B) The holding contact maintains the output after the Start button is released.
 - C) The PLC ignores the Stop button.
 - D) The input module continuously forces the motor ON.

Answer: B

DESCRIPTIVE QUESTIONS

UNIT – I

1. Draw and explain the functional block diagram of an automatic process control system.
2. Explain the components used in a liquid level control system and their functions.
3. Discuss the effects of transportation lag on the performance of a control system
4. Identify and explain the function of each instrument shown in the P&ID of a liquid level control system.

UNIT – II

1. Discuss how proportional, integral, and derivative actions combine in a PID controller.
2. Explain the factors influencing the selection of controller action in process industries.
3. Explain the construction and working of a pneumatic controller.
4. Explain the construction and working principle of the flapper-nozzle mechanism with a neat diagram.

UNIT – III

1. Discuss the importance of controller tuning criteria in minimizing control errors.
2. Compare open-loop tuning and closed-loop tuning methods.
3. Explain the Process Reaction Curve (PRC) Method with a neat diagram.
4. Explain the criteria for selecting a suitable control valve for industrial applications.

UNIT – IV

1. Explain the feed forward control of a heat exchanger with a neat process diagram.
2. Explain the cascade control of a distillation column with a neat schematic diagram.
3. Describe the working of a ratio control system and its industrial significance.
4. Describe how multiple control loops are managed in a Direct Digital Control system

UNIT – V

1. Explain the architecture of a Programmable Logic Controller (PLC) with a neat block diagram.
2. Explain the architecture of a Distributed Control System (DCS) with a neat block diagram.
3. Explain the architecture and working principle of the Fieldbus communication

protocol.

4. Explain the HART communication protocol with a neat block diagram.

ANALYTICAL BASED QUESTIONS

UNIT – I Type -0 Assertion–Reason questions

1. Assertion (A): Continuous processes operate without interruption for long periods.

Reason (R): Raw materials are continuously supplied and products are continuously removed.

- A) Both Assertion (A) and Reason (R) are true, and Reason is the correct explanation of Assertion.
- B) Both Assertion (A) and Reason (R) are true, but Reason is not the correct explanation of Assertion.
- C) Assertion is true, but Reason is false.
- D) Assertion is false, but Reason is true

Answer: A

2. Assertion (A): Measured value is always greater than the set point.

Reason (R): Measured value depends on actual process conditions.

- A) Both Assertion (A) and Reason (R) are true, and Reason is the correct explanation of Assertion.
- B) Both Assertion (A) and Reason (R) are true, but Reason is not the correct explanation of Assertion.
- C) Assertion is true, but Reason is false.
- D) Assertion is false, but Reason is true

Answer: D

3. Assertion (A): A level transmitter provides the feedback signal in a liquid level control system.

Reason (R): The transmitter continuously measures the tank level.

- A) Both Assertion (A) and Reason (R) are true, and Reason is the correct explanation of Assertion.
- B) Both Assertion (A) and Reason (R) are true, but Reason is not the correct explanation of Assertion.
- C) Assertion is true, but Reason is false.
- D) Assertion is false, but Reason is true

Answer: A

UNIT – II Type 6: Arrange the statements in correct order

1. Arrange the following steps in the operation of a closed-loop control system.

1. Controller compares measured value with set point.
2. Sensor measures the process variable.
3. Final control element changes the process.
4. Error signal is generated.
5. Process reaches the desired value

Correct Order: 2 → 1 → 4 → 3 → 5

2. Arrange the events when the flapper moves away from the nozzle.
 1. Air escapes freely.
 2. Relay output decreases.
 3. Nozzle pressure decreases.
 4. Valve position changes.
 5. Process variable changes.

Correct Order: 1 → 3 → 2 → 4 → 5

3. Arrange the controller modes according to increasing complexity
 1. PID
 2. P
 3. PI
 4. ON-OFF
 5. PD

Correct Order: 4 → 2 → 3 → 5 → 1

4. Arrange the signal flow.
 1. Process
 2. Sensor
 3. Comparator
 4. Amplifier
 5. Control element

Correct Order: 2 → 3 → 4 → 5 → 1

UNIT – III Type 1 – Select the correct statements

1. Select the correct statement.

- A. IAE is the integral of the square of the error.
- B. IAE gives equal weight to all errors irrespective of their sign.
- C. IAE ignores small errors.
- D. IAE is used only for derivative controllers.

Answer: B

2. Select the correct statement regarding the Process Reaction Curve.
- A. It is obtained by applying a step input to the process.
 - B. It is measured only under closed-loop conditions.
 - C. It is applicable only to integrating processes.
 - D. It is independent of process dynamics.

Answer: A

3. Select the correct statement regarding a Butterfly Valve.
- A. It is unsuitable for large-diameter pipelines.
 - B. It provides quick operation and compact design.
 - C. It cannot regulate flow.
 - D. It is heavier than a gate valve.

Answer: B

4. Select the correct statement.
- A. Valve characteristics describe the relationship between valve travel and flow rate.
 - B. Valve characteristics are independent of valve opening.
 - C. Valve characteristics apply only to globe valves.
 - D. Valve characteristics affect only valve weight.

Answer: A

UNIT – IV Type 16: Process Sequence

1. Arrange the following steps in the correct sequence
- A. Controller calculates the required corrective action.

- B. Disturbance (change in inlet fluid temperature) is measured.
- C. Control valve adjusts the steam flow rate.
- D. Heat exchanger output temperature is maintained at the desired value.

- (A) $B \rightarrow A \rightarrow C \rightarrow D$
- (B) $A \rightarrow B \rightarrow C \rightarrow D$
- (C) $B \rightarrow C \rightarrow A \rightarrow D$
- (D) $C \rightarrow B \rightarrow A \rightarrow D$

Answer: A

2. Arrange the following sequence.
- A. Computer scans all process variables.
 - B. Individual control algorithms are executed.
 - C. Output signals are generated for each loop.
 - D. All process loops are updated simultaneously.

- (A) $B \rightarrow A \rightarrow C \rightarrow D$
- (B) $A \rightarrow B \rightarrow C \rightarrow D$
- (C) $C \rightarrow A \rightarrow B \rightarrow D$
- (D) $A \rightarrow C \rightarrow B \rightarrow D$

Answer: B

3. Arrange the sequence.
- A. Reflux or steam flow valve is adjusted.
 - B. Product composition returns to specification.
 - C. Master controller updates flow controller set point.
 - D. Composition/temperature controller detects deviation.

- (A) $A \rightarrow B \rightarrow C \rightarrow D$
- (B) $B \rightarrow A \rightarrow C \rightarrow D$
- (C) $C \rightarrow B \rightarrow A \rightarrow D$
- (D) $D \rightarrow C \rightarrow A \rightarrow B$

Answer: D

UNIT – V Type 14: Problematic Questions

1. A conveyor motor should start when the START push button is pressed and continue running after the button is released. It should stop only when the STOP push button

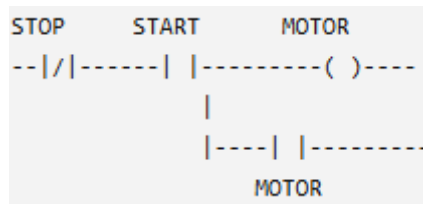
is pressed.

Questions

- a) Which PLC instruction is used to keep the motor running?
- b) Draw the ladder logic concept.
- c) Explain the operation

Answer:

- a) Seal-in (Latching) contact or Holding Circuit.
- b) Ladder Logic Concept



c) When START is pressed, the motor output becomes ON. The auxiliary contact of the motor seals the circuit, keeping the motor ON even after releasing the START button. Pressing STOP breaks the circuit and turns the motor OFF.

- 2. A water tank has low-level and high-level sensors. The pump should start when water reaches the low level and stops at the high level.

Answer:

- Inputs:
 - I0.0 – Low-level sensor
 - I0.1 – High-level sensor
- Output:
 - Q0.0 – Pump Motor

Operation

- Low-level sensor ON → Pump starts.
- High-level sensor ON → Pump stops.