higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS CONTROL
NQF LEVEL 4

XX February 2020

This marking guideline consists of 5 pages.

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QUESTION 1

1.1
- It can prevent having to pay customers for defective equipment.
- Problems should be corrected as they occur and not at the end of production or after delivery.
- Time is saved by efficiency as work doesn't need to be repeated.
- The company's positive image is maintained.
- Employees are motivated, enthusiastic and take pride in services and products.
- Money is saved because material is not wasted.
- Safety is ensured. (Any 5 × 1) (5)

1.2 A – Identify measurable attributes of processes
B – Characterise natural variation of attributes
C – Track variation
D – Process control is applied
E – Identify assignable cause
F – Remove assignable cause (6 × 1) (6)

1.3 1.3.1
- Environmental factors
- Different techniques used by operator
- Regular rotation of machines
- Difference in measuring or testing devices (Any 2 × 1) (2)

1.3.2
- Wear of equipment
- Technique has deteriorated or improved.
- Accumulation of waste products
- Changes in environmental conditions
- Changes in proportions or properties of raw materials

(Any 2 × 1) (2)

1.4
- Objective of the actions that will be taken
- Procedure to be followed
- Personnel that will be responsible
- Any other anticipated resources needed (4)

1.5
- Cheap
- Easy installation (2)

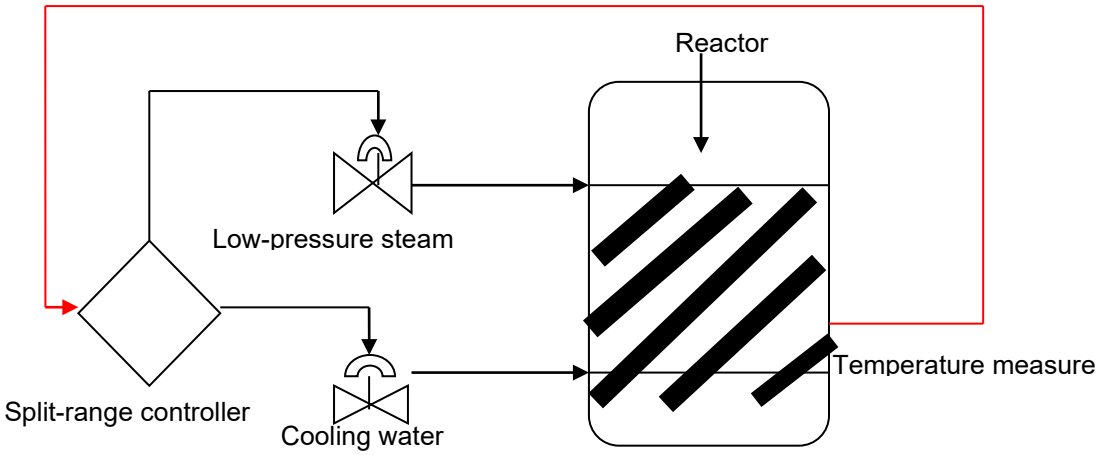
1.6 Laminar flow occurs when the average velocity of a fluid is relatively low and the particles move smoothly✓✓while turbulent flow occurs when the flow velocity is high and the particles no longer flow smoothly in layers but roughly.✓✓ (4)
[25]

QUESTION 2

2.1
- Electromagnetic analysers
- Electrochemical analysers
- Process chromatography
- Mass spectrometer
- Automated wet chemistry
- Combustible gas detectors
- Solid state sensors (Any 5 × 1) (5)

2.2 Automatic control is a process control system that automatically controls the entire process✓ without human input or intervention.✓ It is used when a process is operating normally.✓ The role of the operator is to adjust the value of the set point✓ and the controller generates an output signal that maintains the controlled variable at set point.✓ The automatic controller relies on feedback from sensors.✓ (6)

2.3



(5)

2.4
- Holding a constant reflux ratio on a distillation column
- Controlling the ratio of two reactants into a reactor
- Holding the ratio of two blended streams constant to maintain composition
- Holding a constant ratio between the feed flow rate and steam (4)

2.5 The disturbance and the manipulated variable are inputs into the system and one output from the system.✓ The disturbance is a variable that cannot be controlled.✓ It can be a stream from another part of the plant.✓ The disturbance changes the output from the process by keeping the output at a desired value.✓ The manipulated variable is the variable that can be changed and used to control the output.✓ (5)

[25]

QUESTION 3

3.1 3.1.1 Measures disturbances and other causes of effect in a process

3.1.2 Shows all the components of a large distribution system

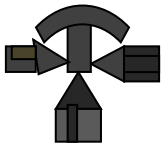
3.1.3 Receives process signals or processes measurements from the transmitter and compares the signal to a set point

(3 × 2) (6)

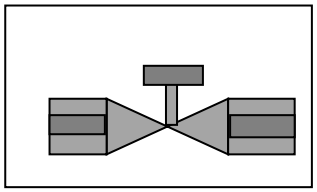
3.2
- Programmable controllers
- Stand-alone controllers
- Hydraulic controllers
- Batch process controllers (4)

3.3 It is a simple computing device✓ which is not implemented in standard process plants.✓ They are used for certain plants such as sequencing, interlock operations.✓ The user enters a program which is software that gives the necessary results.✓ The PLC designs and implements a sequence of logical decisions.✓ This is done by looking at the input and calculating an output which depends on the state of the input.✓ (6)

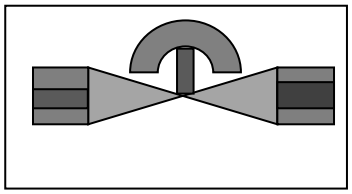
3.4 3.4.1



3.4.2



3.4.3



(3 × 3) (9)
[25]

QUESTION 4

4.1
- Feed flow control:✓ It ensures that the feed rate from outside is perfectly constant since sudden changes will upset the product compositions and purity.✓
- Bottom level control:✓ Any build-up of liquid in the column bottom is discharged as the bottom product through the bottoms pump.✓
- Bottom temperature control:✓ The purity of the bottom product is largely determined by the temperature of the bottom. If the temperature is too low, the product will not be pure enough and if too high it will waste energy.✓
- Reflux drum-level control:✓ Any build-up of liquid in the reflux drum is discharged as overhead product by the reflux pump.✓
- Reflux flow control:✓ The most important part of the distillation column.✓
- Column pressure control:✓ The column pressure is controlled by the pressure control valve in the off-gas line.✓ (6 × 2) (12)

4.2 Process description
Determine which control loops are responsible for controlling the process✓
Ratio control using inputs from FT1, FT2, FT3, FC4 to determine the set points for FC1, FC2, FC3✓
Feed-pump flow control is set✓
Reactor temperature control✓
Mixer power control✓
Reactor level control✓

Process logics
Describe the logics of each loop✓
The ratio controller ZC1 uses the set point from FC4 to set the set points of FC1, FC2 and FC3 at 80%, 15% & 5% of the FC4 set point. The flow controllers (FC1, FC2 and FC3) compare the actual flows through FT1, FT2 and FT3, and open and close the control valves in each of the streams to match the set point✓
The output of the feed pump is controlled by the flow controller FC4 according to the set point given to it✓
The temperature in the mixing tank is measured by TC1 and compared to its set point of 45 °C. If it is too cold, TC1 opens the steam valve, and if it is too hot it will close the steam valve✓
The maximum power drawn by the mixer motor is measured by the power controller (JC). If it goes above the set point, the controller will slow it down until the set point is reached✓
The level of the tank is controlled by a level controller (LC1) linked to the product pump outlet control valve. If the level gets too high, it opens the valve more, if it gets too low, it closes the valve more.✓ (13)
[25]

TOTAL: 100

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