B.E. Instrumentation Engineering (Model Curriculum) Semester-VI

IN603M - Process Automation

P. Pages : 3 **GUG/W/23/14030**

Time : Three Hours * 7 6 1 7 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Give the list of "Automation Types", Explain each type in brief. **8**

b) Explain the "process characteristics" with example. **8**

i) Process Equation

ii) Process lag/Dead-time/transportation lag.

iii) Self Regulation

iv) Process Load.

OR

2. a) Explain "Degrees of Freedom" with suitable example. **8**

b) A controller outputs a 4-20 mA signal to control motor speed from 140 to 600 rpm with linear dependence. Calculate: **8**

a) Current corresponding to 310 rpm

b) The value of (a) expressed as the percentage of control output.

3. a) Explain "floating-Control Mode" with suitable waveforms. **8**

b) A liquid level control system linearly converts a displacement of 2 to 3m into 20 mA control signal. A relay serves as the two-position controller to open or close an inlet valve. The relay closes at 12 mA and opens at 10 mA. **8**

Find

a) The relation between displacement level and current

b) The neutral zone or displacement gap in meters.

OR

4. a) Discuss Integral-Control Mode with suitable waveforms and summarize the characteristics of the Integral mode. **8**

b) Consider the proportional-mode level control system of below Figure. Valve-A is linear, with a flow scale factor $10m^3/h$ per percent controller output. The controller output is nominally 50% with a constant $K_P = 10\%$. A load change occurs when flow through valve-B changes from $500m^3/h$ to $600m^3/h$. Calculate the new controller output and offset error. **8**

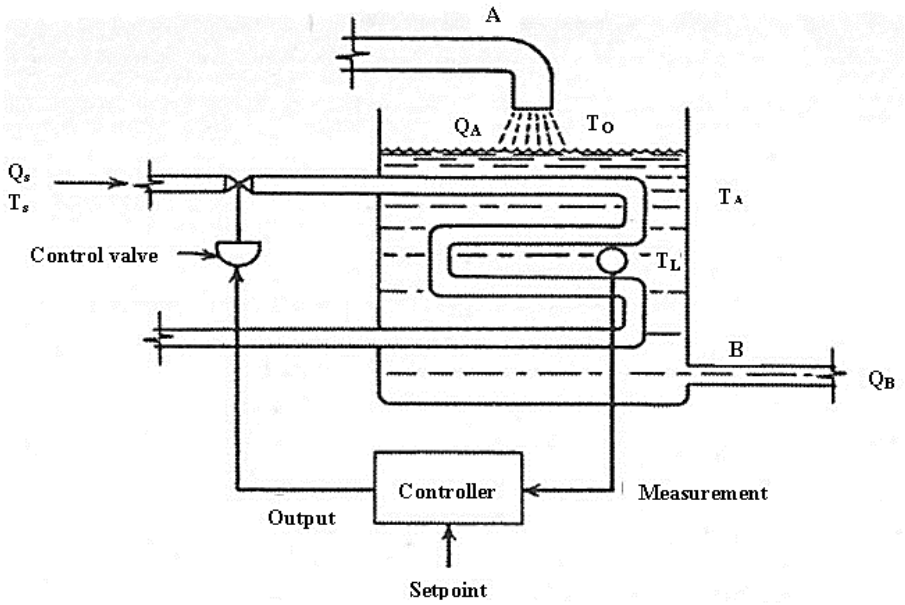


FIGURE Control of temperature by process control

5. a) Explain Feedforward Control Systems which are often encountered in following Chemical process. **8**

a) Heat Exchanger b) Drum Boiler
c) Distillation Column d) CSTR

b) List the control systems with multiple loops. Also explain cascade control for a Jacketed CSTR. **8**

OR

6. a) Explain "Programmed/Scheduled Adaptive Control" with block diagram. **8**

b) When "Split-Range Control" is used? Explain it for chemical reactor with suitable diagrams. **8**

7. a) Explain the different parts of PLC in detail. Also list advantages and disadvantages of PLC. **8**

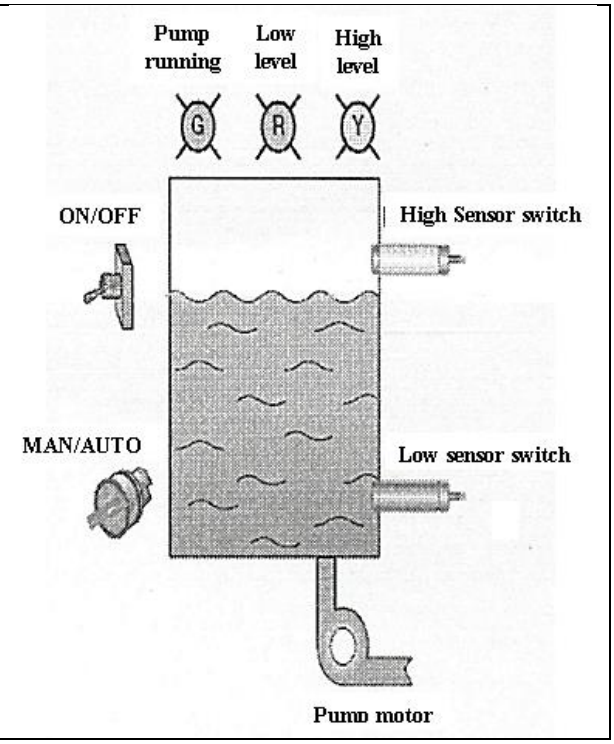
b) Explain typical "AC Discrete Input Module" with suitable diagrams. **8**

OR

8. a) Explain "Analog I/O Modules" with suitable diagrams. **8**

b) Design a PLC ladder logic program for level control in storage tank by turning a discharge pump ON or OFF as shown below:

The modes of operation are as follows:
OFF Position: The water pump will *stop* it is running and will *not* start if it is stopped.
Manual Mode: Pump will start if water in tank is at any level except low.
Automatic Mode: • If the level of water in the tank reaches a high point, the water pump will *start* so that water can be removed from tank, thus lowering the level. • When the water level reaches a low level point, the pump will stop.
Status Indication Lights: • Water pump running light (Green) • Low water level light (Red) • High water level (Yellow)



9. a) Explain with a neat sketch the structure of a distributed control system (DCS). Discuss the functioning of its various parts. **8**

b) What are the different types of displays available on a video screen of the DCS for plant information? Explain each one with a sample screen diagram. **8**

OR

10. a) What is the difference between a PLC and DCS? How are PLC and DCS integrated for industrial process control? **8**

b) How is DCS programmed? How is the DCS configured to provide desired information? **8**

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