Reg. No. : | | | | | | | | | | |

Question Paper Code: 31663

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Sixth Semester

Instrumentation and Control Engineering

01UIC603 - PROCESS CONTROL

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

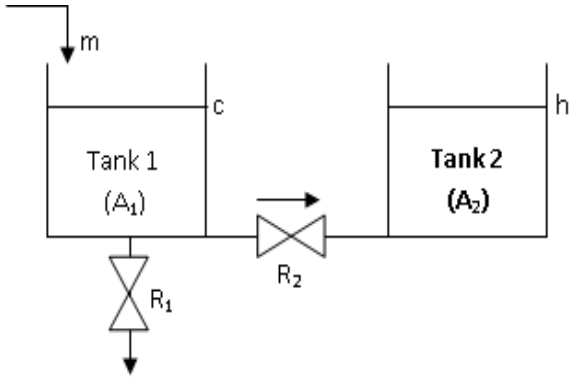
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. List the need for process control.
2. List the steps involved to obtain the mathematical model.
3. Identify why the Derivative mode cannot be used as standalone controller?
4. Draw and label the response of P, P+I, P+I+D controllers for step change in set point.
5. When can IAE and ISE be used as evaluation criteria for assessing the performance of a controller? Justify your answer with a suitable example.
6. Contrast feedback control with feed forward control.
7. An equal percentage has a maximum flow of 50 m^3/s and a minimum flow of $2m^3/s$. If the full travel is 3 cm, calculate the flow at a 1 cm opening.
8. Discuss why cavitation in a control valve is so dangerous?
9. How the mixture of components separated in the distillation column? List the two types of distillation column.
10. Differentiate an evaporator process from dryer process. Give a suitable example.

PART - B (5 x 16 = 80 Marks)

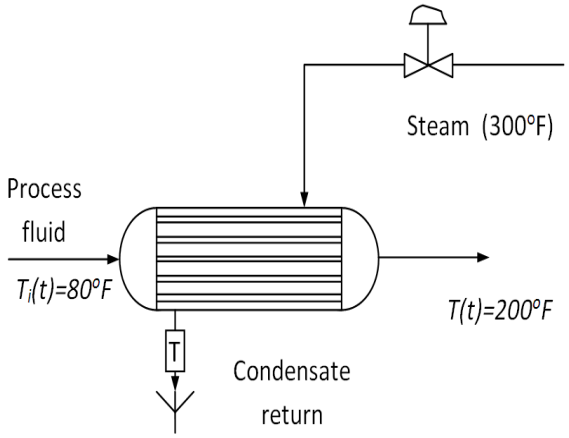
11. (a) (i) Develop the transfer function model of a given liquid system shown in figure below. Consider the input variable is 'm' and the output variable is 'c'. (8)



(ii) Explain the servo and regulator operation with an example. (8)

Or

(b) (i) Consider the heat exchanger shown in figure. (10)



(a) The control objective of this system. Construct a feedback control configuration.

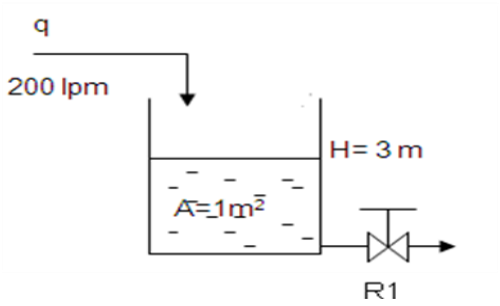
(b) All the external disturbances that will affect the operation of the exchanger.

(c) All the available manipulated variables for the control of the exchange in the presence of disturbances.

(d) Find the degrees of freedom of the heat exchanger process shown in figure.

(e) How many control loops required to meet the perfect process.

(ii) In the tank shown in figure below, at t=0, inflow is suddenly increased to 220 lpm. Calculate the final steady state value, time taken to reach final steady state value and 90 % of steady state value. (6)



12. (a) (i) A water tank losses heat such that the temperature drops by 2K/min. when the heater is ON, the system gains temperature at 4K/min. An ON-OFF controller has a 0.5 min control lag and a Differential gap of +/-4% of the set point around 323 K. Plot the heater temperature Vs time and calculate the oscillation period. (8)

(ii) A second order process with transfer function of $\frac{5}{(10s+1)(3s+1)}$ is controlled by a proportional controller. Estimate the value of proportional gain (k_c) so that the offset due to unit step change in set point is 0.05? (8)

Or

(b) A temperature control system inputs the controlled variable in a range of (0 - 4) V. The output is a heater requiring (0 - 8) V. A PID controller is to be designed with Kp = 2.4 % / %, Ki = 0.9 % / % min, and Kd = 0.7 % / % /min. The period of the fastest expected change is estimated to be 8 sec. Design and draw an electronic PID circuit. Assume CD =100 μF; R1 = 10 KΩ ; CI = 10 μF. (16)

13. (a) (i) Calculate the optimal tuning parameters of P, PI, and PID controllers using ZN closed loop method for a given system below

$$G(s) = \frac{5e^{-0.5S}}{2.5S+1}$$

Use frequency response to find the ultimate gain and ultimate period. (10)

(ii) Describe the procedure for PID Auto tuning using relay feedback test with a neat diagram. (6)

Or

(b) (i) With a suitable example explain the concept of split-range control (8)

(ii) Describe the inferential control with a suitable example (8)

14. (a) (i) Describe the function of an actuator. List the types of actuators. (6)

(ii) Describe the working principle of pneumatic spring actuator with valve positioner with a help of neat sketch. Mention the drawback of control valve without positioner. (10)

Or

(b) (i) Explain the three types of flow lift characteristics with a help of neat valve plug diagrams. Why the installed characteristic of control valve is differ from its inherent characteristic. (8)

(ii) The liquid flow through a Diaphram type control valve has to be varied from 300 gpm to 1100 gpm. The pressure drop across the valve varies from 20 to 45 psig. Design the optimum size of the valve required, if the liquid density is 0.9. (8)

15. (a) Discuss the rationale of a cascade control system in CSTR process and illustrate why it provides better response than simple feedback with a neat P&I layout. (16)

Or

(b) Illustrate the Reflux and Reboiler control schemes in distillation column with neat sketch. Describe how the interaction affects the quality of both top and bottom products. (16)

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