53 (IE 601) PRCN

2017

PROCESS CONTROL

Paper : IE 601

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions from **seven**.*

1. *(a)* Obtain the complete transfer function relating the variables of the system for the process shown in *Figure-1*. 10

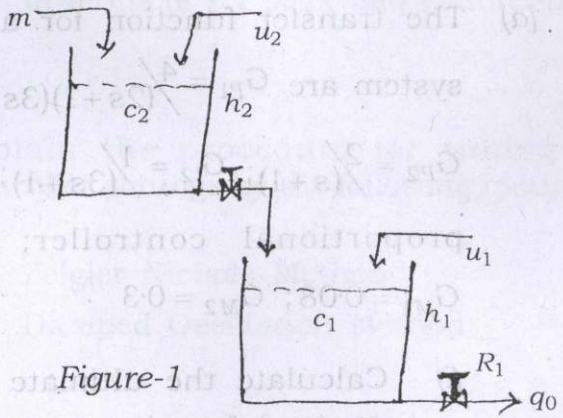

Figure-1

Design the complete block diagram representation of above system with the inputs m, u_2 and u_1 and output h_1.

Contd.

(b) With example, explain the process with inverse response. 10

2. (a) Given the error values plot a graph of a proportional-integral controller output as a function of time K_p = 5, K_i = 1·0 sec^{-1} and $P_i(0)$ = 20%.
From 0–1 *sec*, $e=t$, From 1–3 *sec*, $e=1$, From 3–5 *sec*, $e=0$. 12

(b) Design pneumatic controller with one proportional control action and two integral action (PI–I). Derive its Transfer function. 8

3. (a) The transfer function for a cascade system are $G_{P1} = \frac{4}{(2s+1)(3s+1)}$;

$G_{P2} = \frac{2}{(s+1)}$; $G_{l2} = \frac{1}{(3s+1)}$; G_{c1} is a proportional controller; $G_{c2} = 6$;

$G_{M1} = 0{\cdot}08$; $G_{M2} = 0{\cdot}3$

(i) Calculate the ultimate value of $Kp_1(Gc_1)$ for primary controller for which simple feedback and cascade loop go into oscillations.

(ii) Compare the offset for simple feedback and cascade loop when $Kp_1 = 20$.

10

(b) Inflow to a tank having area A is m_1 (manipulated variable) and outflow q_0 is through a resistance R. Load is downstream head u. Design a Feed Forward – Feedback control configuration for this system. The Measuring Elements have first-order transfer function with characterizing parameters as unity. Final Control Element has unity transfer function. A P–controller having gain, k, is in place to provide feedback. Draw the block diagram, and express height in tank in terms of set point and disturbance.

10

4. Explain the procedure for tuning the controller settings by the following methods :

20

(i) Zeigler Nichols Method

(ii) Damped Oscillation Method.

5. (a) What is split range control ? Describe a situation where you could use split range control. 10

(b) With a neat diagram explain the principle of an I/P converter. 10

6. (a) Explain the occurrences of cavitation and flashing in control valve. 8

(b) Explain the types of control valves with their characteristics related to stem position and flow rate. 6

(c) Find *(i)* The proper *Cv* for a valve that must pump 150 gallons of ethyl alcohol per minute with a specific gravity of 0·8 at maximum pressure of 50 *psi* *(ii)* The required valve size. 6

Valve Size	1/4	1/2	1	1 1/2	2	3	4	6	8
Cv	0·3	3	14	35	55	108	174	400	725

7. (a) What are the degrees of freedom of a Heat Exchanger ? 4

(b) Explain the principle of drying process using *any one* type of dryers. 8

(c) Explain the operation of *any one* evaporation process. 8
