**2019**

# PROCESS CONTROL

Paper : IE 601

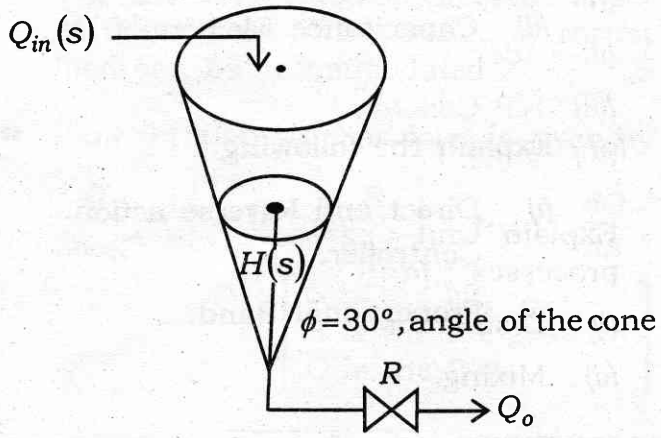
*Full Marks : 100*

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* For the conical shape vessel shown in the figure, find the Transfer function $H(s)/Q_{in}(s)$. 15




*Contd.*

(b) What are the advantages of Process Control ? 5

2. (a) Explain the following important characteristics of Fluid and Gas media with reference to storage of liquid in tank and fluid flow in a pipeline.

(i) Continuity Law for liquid in Tank

(ii) Liquid Capacitance. 10

(b) Discuss the following elements used to study Process Dynamics and identify the input and output process variables.

(i) Proportional Element

(ii) Capacitance Element. 10

3. (a) Explain the following :

(i) Direct and Reverse action Controller. 5

(ii) Proportional Band. 5





(b) A PI controller is used to control the pressure in a tank which varies from 40 *psi* to 140 *psi*. Desired pressure is 90 *psi*. Controller output is to change by 100% upon 40 *psi* pressure duration. Reset Rate is 1/5 repeats per minute and controller output at zero error in 50%. Calculate the controller output at the end of 2 minutes, when pressure in the tank become 80 *psi*. 10

4. (a) Define Rangeability, $C_V$, Turndown ratio of a valve. 6

(b) Derive the relationship of % lift versus % flow the equal percentage valve. 4

(c) A springless pneumatic actuator has a diaphragm of 500 $cm^2$ area. Its positioner operates from 0·2 to 1 $kg/cm^2$. The underside cushion pressure is set at 0·3 $kg/cm^2$. What range of thrust load can be accommodated ? 5

(d) Flow through a linear valve is given by

$$\frac{Q}{Q_{max}} = \frac{1}{R}\left[1+(R-1)\frac{S}{S_{max}}\right], \text{ find } \frac{dQ}{dS},$$

[$S$ is the lift,
$R$ is the Rangeability,
$Q$ is the flow.] 5

5. *(a)* Explain the following terms for controller : 6

   *(i)* ISE

   *(ii)* IAE

   *(iii)* ITAE

   *(b)* Explain the procedure for tuning the Controller Settings by Ziegler-Nichols method. 6

   *(c)* Explain with a simple process application, the working of Cascade Control System. Also, explain with a block diagram the preferred choice of controllers and its type of control action. 8

6. Write short notes on : ***(any two)*** 20

   *(i)* Ratio Control

   *(ii)* Adaptive Control

   *(iii)* I/P Converter

   *(iv)* Valve Positioner.

7. Explain Unit operations for the following processes : ***(any one)*** 20

   *(i)* Distillation

   *(ii)* Mixing.

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