

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 161702**Date: 23/11/2011****Subject Name: Process Control****Time: 10.30 am -1.00 pm****Total marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What is Process control? Explain objectives of the process control. **07**
(b) Draw the process and instrument elements of the feedback loop. **07**
Explain function of each element with its typical range.

- Q.2** (a) What are the advantages of the feedforward control over feedback control? Derive the equation for the feedforward controller using block diagram. **07**
(b) Derive the transfer function of the two non-interacting series tank. **07**

OR

- (b) For isothermal CSTR show in Fig. 1 has volume of the tank = 2.1 m^3 , input flow $F = 0.085 \text{ m}^3/\text{min}$ and concentration C_{A0} produce output concentration of C_A with chemical reaction rate $= (-0.5)C_A^2$. Develop the mathematical model and linearised for the operating point $C_{AS} = 0.22$. Derive its transfer function for the same operating point. **07**

- Q.3** (a) What are the different elements of the process dynamics? Explain any two with example. **07**
(b) Explain two scheme of the ratio control with help of the block diagram. **07**

OR

- Q.3** (a) What is the use of the recycle structure? Explain with help of the example. **07**
(b) Explain split range control with the help of example. **07**

- Q.4** (a) Define process load, process lag and rate gain with the help example. **07**
What is the unit of the reset gain?
(b) A PI controller has $K_p = 10$, $K_I = 0.5 \text{ sec}^{-1}$ and $P_I(0) = 30\%$. Plot the output as function of time for an error given in Fig. 2. **07**

OR

- Q.4** (a) Define the proportional band in proportional controller? Explain how the offset is reduced by increasing the proportional gain. **07**
(b) For a proportional controller, the controlled variable is a process temperature with a range of 50 to 130 °C and a setpoint of 73.5 °C. Under nominal conditions, the setpoint is maintained with an output of 50 %. Find the percentage controller output with a proportional gain of 2 if the temperature is (i) 61 °C (ii) $(82 + 5t)$ °C. **07**

- Q.5** (a) Explain the different key factors for the tuning of the controller. **07**

- (b) Check the stability and stability limit of the three-tank mixing process with transfer function $(0.039)/(5s+1)^3$. Tune the PI controller using Ziegler-Nichols closed loop method by use of above result. **07**

OR

- Q.5** (a) Explain Ziegler- Nichols closed-loop and open-loop method. **07**
 (b) Give the example of temperature-flow cascade control system. **07**
 Explain the design criteria for the cascade control.

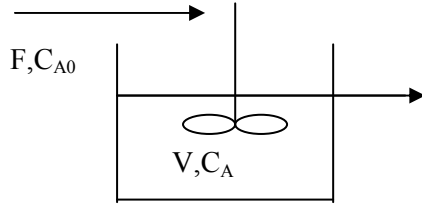


Fig. 1

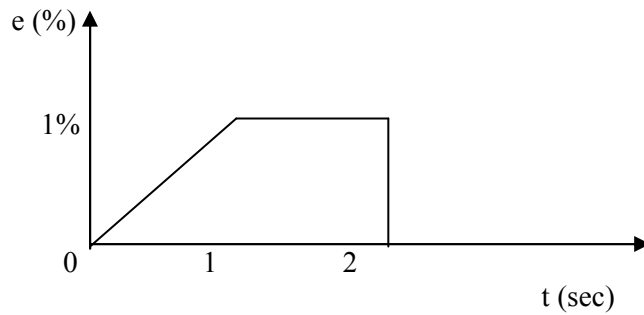


Fig.2
