

**BITS, PILANI - DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI**  
**IV YEAR, FIRST SEMESTER 2004-2005**  
**INSTR UC451- PROCESS CONTROL**  
**COMPREHENSIVE EXAMINATION (Closed Book)**

Maximum Marks : 80  
 Time : 3 HOURS

Date :09.01.2005  
 Weightage : 40 %

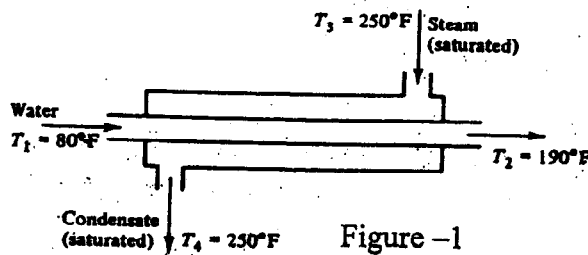
**NOTE:**

1. ANSWER ALL QUESTIONS FROM PART-A AND ANY SIX QUESTIONS FROM PART - B
2. ALL THE SYMBOLS CARRY THEIR USUAL MEANING UNLESS OTHERWISE INDICATED
3. ANY MISSING DATA CAN BE ASSUMED, BUT NEED TO BE MENTIONED

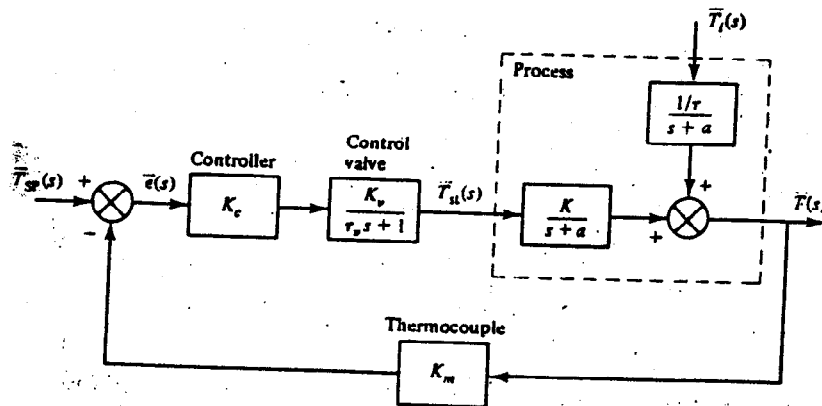
**PART - A**

**( 2 x 10 =20)**

1. For the given process shown in figure -1, identify the control objective and all the external disturbances that will affect the operation of the process



2. Why do we need to develop the mathematical model of a process? Explain
3. Explain the methods to reduce the number of degrees of freedom to zero, so that the system can be completely specified
4. Derive the transfer function of the system shown in figure -2



5. Which one of the three controllers (P, PI, PID) give more robust closed loop response to an under damped second order system. Justify your answer
6. Is it possible to design a controller that minimizes the overshoot and settling time simultaneously? Explain
7. What are the two undesirable effects take place as the dead time of an open loop transfer function increases
8. What is the advantage of cascade control? Explain the cascade control with an example
9. What does auctioneering control mean? Explain with an example
10. What is MIMO system? List out any four design questions related to MIMO system

**PART - B**

( 6 x 10 =60)

11. (a) Design the generalized feed forward controller for disturbance rejection and set point tracking with measuring device and final control element  
 (b) Design the feed forward controller If  $G_p(s) = 10 / (s+1)$  ,  $G_d(s) = 2 / (s+1) (5s+1)$  and  $G_m = G_f = 1$
12. Derive the transfer function of the process shown in figure -3. Analyze the effect of proportional controller on the response of the process for both servo and regulatory problem

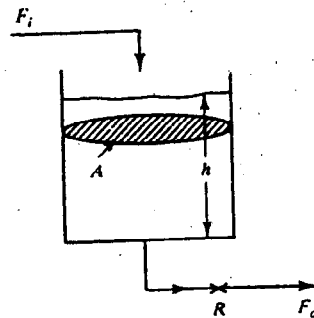


Figure -3

13. (a) Explain scheduled adaptive control with an example  
 (b) What is STR. Explain in detail with the block diagram
14. Find the gain of the proportional controller that produces a closed loop response for the second order system with decay ratio equal to  $1/4$ . The process is described by

$$G_p(s) = 1 / (S^2 + 3S + 1) \text{ and } G_m = G_f = 1$$

15. Consider the process with the transfer function

$$G_p(s) = \{1/(3s+1)\} - \{5/(s+1)\}$$

- (a) Show that this process exhibit inverse response
- (b) Design a perfect inverse response compensator

16. Identify the control systems involved with the process shown in figure- 4. Explain the working principle of each control systems in detail

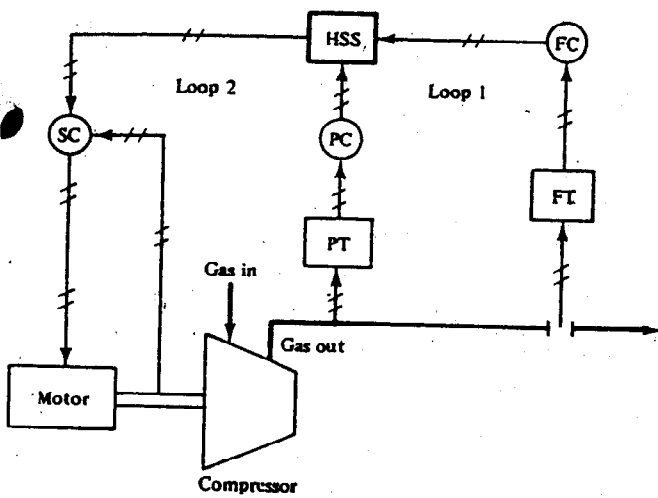


Figure 4(a)

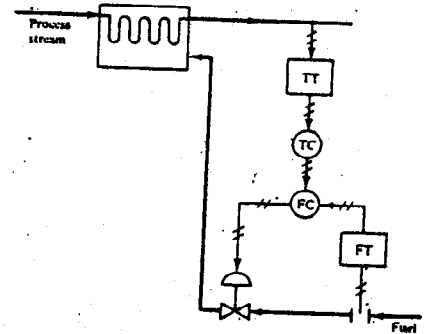


Figure 4(b)

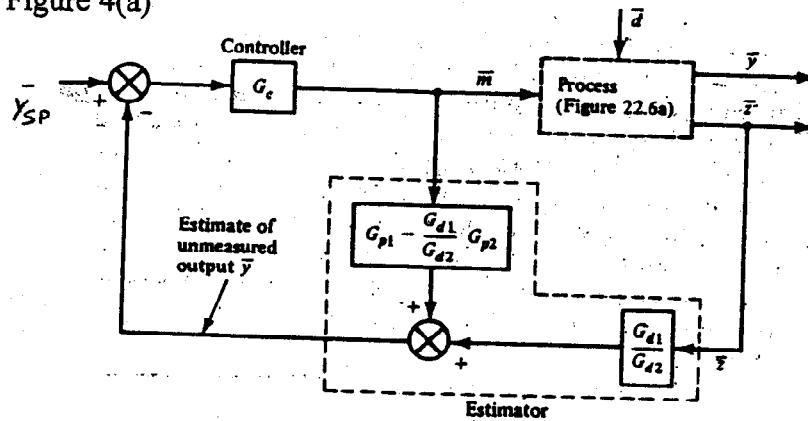


Figure 4(c)

17. For the given open loop transfer of the system, find the ultimate gain and ultimate period.

Which tuning method uses the above parameters for the controller tuning

$$G_{OL} = 12.5 e^{-0.204 S} / (10.99 S + 1)$$