BITS, PILANI - DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI
IV YEAR, SECOND SEMESTER 2004-2005

INSTR UC451- PROCESS CONTROL
TEST – 2(OPEN BOOK)

Maximum Marks : 20 **Date : 24.04.2005**

Time : 50 minutes **Weightage : 20 %**

Answer ALL Questions.

1. Find the gain of the proportional controller that produces a closed loop response for the second order system with decay ratio equal to ¼. The process is described by

   $G_p(s) = 1 / (s^2+3s+1)$ and $G_m = G_f = 1$ [4]

2. Examine the effect that various values of the gain K_m of a measuring device will have on the closed loop response of the following transfer function.

   $G_p(s) = 1 / (s+1)(2s+1)$ Assume that $G_m = K_m$, $G_f = 1$ and the controller is proportional with $K_c = 1$. Also comment the effect of K_m on offset [4]

3. The open loop transfer function of a unity feedback control system is given by

   $G(s) = K / (s+2)(s+4)(s^2+6s+25)$

   By applying the routh criterion determine

   (a) The range of K for which the closed loop system will be stable
   (b) The value of K for which the closed loop system will oscillate [4]

4. The Nyquist plot of $G(s) = k(1+0.5s)(1+s) / (1+10s)(s-1)$ is shown in figure -1. If the value of K is 8, Comment on the stability of open loop and closed loop system. [4]

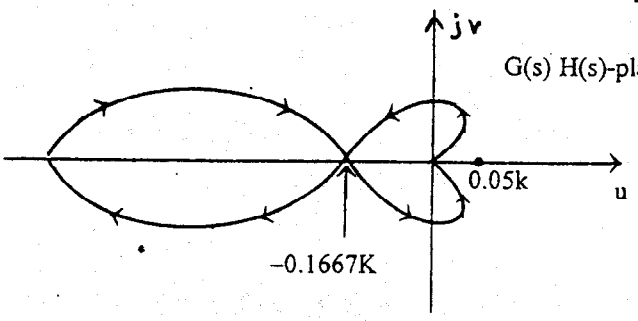

Figure -1

5. Transfer function of two different systems $G_1(s)$ and $G_2(s)$ are given below .Identify which system has inverse response and why . Where [4]

   $G_1(s) = \{10 / (0.1s+1)\} - \{5/(0.04s+1)\}$, $G_2(s) = \{10 / (0.2s+1)\} - \{5/(0.3s+1)\}$

BITS, PILANI - DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI
IV YEAR, FIRST SEMESTER 2004-2005

INSTR UC451- PROCESS CONTROL
- 1(CLOSED BOOK)

QUIZ

Maximum Marks	: 30	Date : 03.04.2005
Time	: 30 minutes	Weightage : 10 %
Name	:	**Id.No. :**

Answer ALL Questions.

1. Non interacting capacities always results in an ---------- damped system or an ---------- damped system and never in an ---------- damped system

2. In connection to the response of the second order system for a step change in input shown in figure -1 , The ratio of A/B is called ----------and the ratio of C/A is called ----------

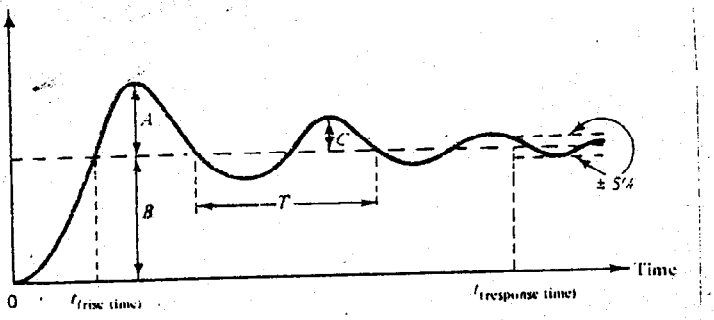

Figure – 1

3. For the system shown in figure – 2 ,the transfer function between the external output h(s) and the input F_i (s) is of ---------- order

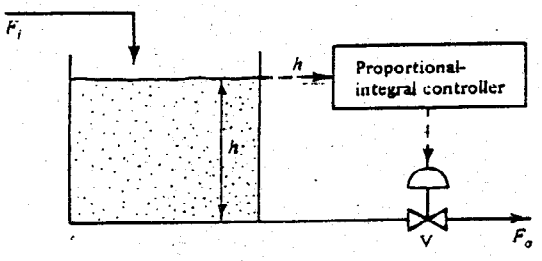

Figure – 2

4. The overall response shown in figure – 3. is called ---------- response. It is the net result of ---------- system and ---------- system in opposite direction

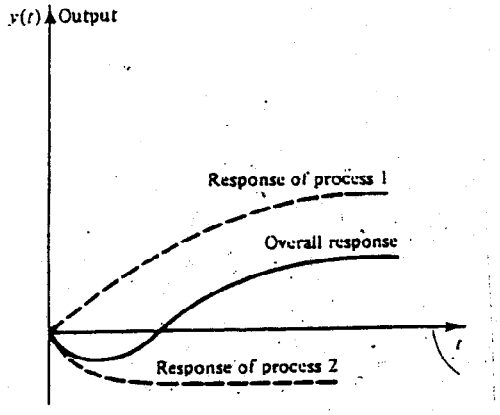

Figure – 3

5. For the second order system given below ,if we introduce a unit step change in the input, the response will have a percentage overshoot of ----------

$$G(s) = 1/(s^2 + s + 1)$$

6. The response of 4 different processes for a step input change is shown in figure – 4. Match the response with the process

Response ---------- is for two interacting tank process

Response ---------- is for two non interacting tank process

Response ---------- is for four interacting tank process

Response ---------- is for first order process

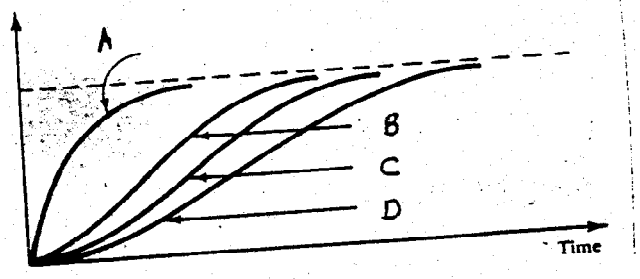

Figure – 4.

7. The response of ---------- controller is shown in figure – 5. The equation of the given controller output c(t) is ----------

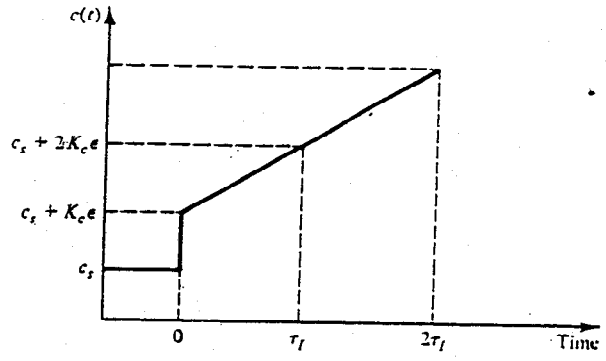

Figure – 5.

8. If a closed loop system has first order process with $K_p = 5$ & $\tau_p = 2$, $G_m = G_f = 1$, $G_d(s) = 5 / (2S + 1)$ and $G_c = 2$ and a change in the load is a unit step change, then ---------- is the offset in the response

9. If the gain of the proportional controller is increased the time constant of closed loop system ---------- . Which means that the closed loop system become ---------- than the open loop system to changes in set point

10. If the integral time increases the damping factor of closed loop response ---------- and the natural period of oscillation of closed loop response ---------- compared to the open loop response of the process for the unit step change in input

11. The closed loop system has a process transfer function $G_p(s) = 2 / (4s+1)$ and derivative controller gain = 5 , $G_m = G_f = 1$, The overall time constant of the System is ----------

12. In connection with closed loop control system , the derivative control action produces more robust control due to ---------- in the speed of response and ---------- in the damping ratio

13. (a) The closed loop system has a process shown in figure – 6, and $G_m = G_f = 1$, and $G_c = 0.5$ The closed loop transfer function has

G_{sp} (s) ---------- and G_{load} (s) ----------

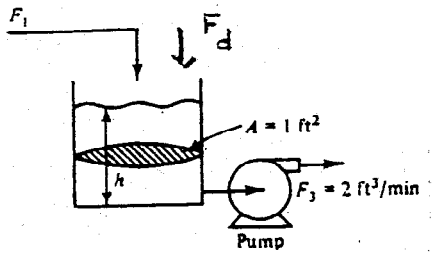

Figure – 6

(b) For the closed system shown in figure – 7, the closed loop transfer function has

G_{load} (s) ----------

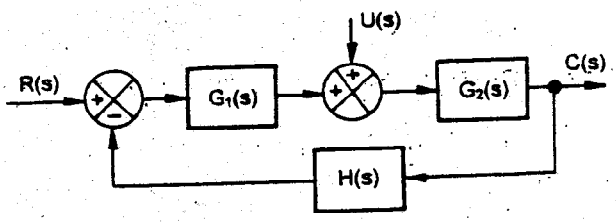

Figure – 7

14. For the constant nonzero error ---------- controller gives no control action

15. Fill in the blanks in connection to P+I controller effect on closed loop response . If the integral time decreases for constant K_c ,the response become ---------- and becomes ----------oscillatory .

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IV YEAR, SECOND SEMESTER 2004-2005

INSTR UC451- PROCESS CONTROL
TEST – 1(CLOSED BOOK)

Maximum Marks : 20 Date : 13.03.2005

Time : 50 minutes Weightage : 20 %

Answer ALL Questions. (5 x 4 = 20)

1. Develop the mathematical model for the two CSTRs system shown in figure –1. A simple reaction A → B with first order kinetics takes place. Assume isothermal conditions. Flow rates F1 and F2 are determined by variable speed pumps and they are independent of the corresponding liquid levels.

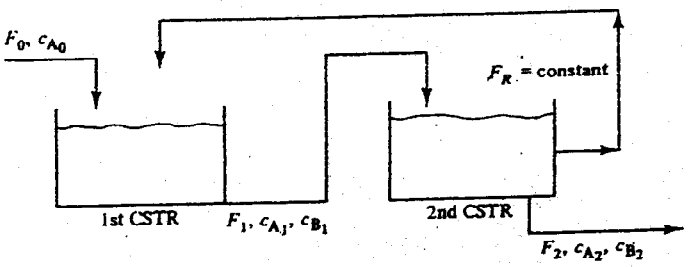

Figure-1.

2. For the simple chemical plant shown in figure -2
   (a) List out the operational objectives
   (b) List out the disturbances that will affect the operational objectives

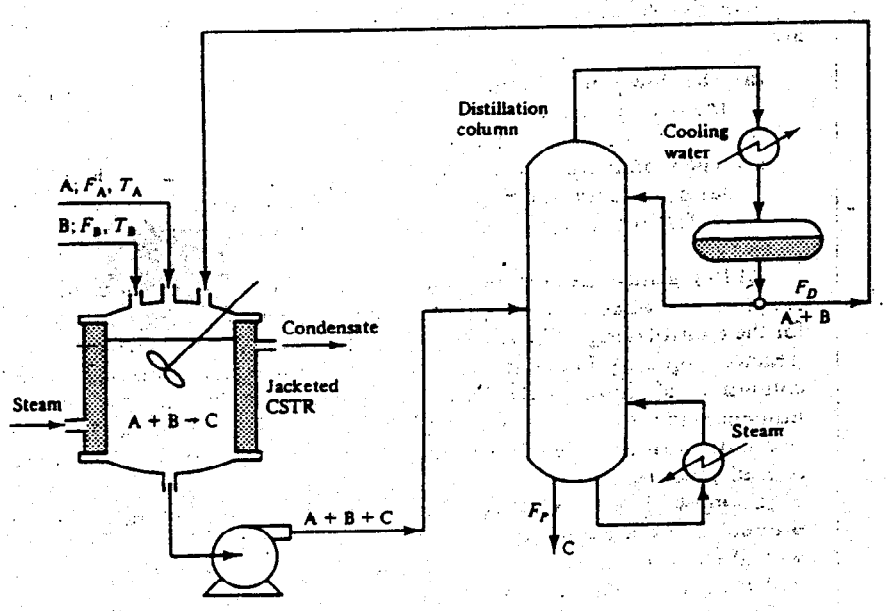

Figure –2.

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

Maximum Marks : 80
Time : 3 HOURS

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. What is an input output model and how can you develop it from the state model? When is this possible?
2. Compare feedback and feed forward controllers
3. List out the effect of PI control on the response of closed loop system
4. What is meant by STR . explain with block diagram
5. With an example explain the principle of operation of ratio controller
6. Draw the bode plot of PD and PI controller
7. Larger the gain margin implies smaller or larger allowable gain? justify your answer
8. Describe in physical terms the concepts of dead time compensation. Why is such a system also called a predictor?
9. Process transfer functions are given below. Find the transfer function of main feed forward controller and comment on it

$$G_p(s) = 10\, e^{-0.5s} / (2s+1) \;,\; G_d(s) = 2\, e^{-0.2s} / (2s+1)$$

10. List out the time integral criteria and explain the need of it

PART – B

(6 x 10 =60)

11. Construct the Nyquist plot for a system whose open loop transfer function is given by

$$G(s)H(s) = K / s(s+2)(s+10)$$