

**BITS,PILANI- DUBAI CAMPUS**

**Knowledge Village, Dubai**

**Year IV – Semester II 2005 – 2006**

**TEST II (OPEN BOOK)**

**Course No: INSTR UC451**

**Course Title: Process Control**

**Date: 03.05.06**

**Time: 50 Minutes**

**M.M = 20(20%)**

**NOTE: ONLY TEXT BOOK IS ALLOWED**

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

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

By applying the Routh criterion determine the range of K for which the closed loop system will be stable. (3 Marks)

2. Sketch the root locus for the unity feedback system whose open loop transfer function is

$$G(s) = K / s(s^2+6s+10)$$

(6 Marks)

3. Plot the bode diagram for the following transfer function and obtain the gain cross over frequency. (Assume lower frequency as 0.15 rad/sec and higher frequency as 1 rad/sec).

$$G(s) = 20 / s(1+3s)(1+4s)$$

(6 Marks)

4. a. Sketch the polar plot for the given transfer function.

$$G(s) = 1 / s^2(1+sT_1)(1+sT_2)$$

(2 Marks)

- b. Which complex control is the special type of feed forward control? (1Mark)

- c. What do you mean by Auctioneering control. Give two examples. (2Marks)

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COMPREHENSIVE EXAMINATION (Closed Book)

Course No : INSTR UC451

Course Title : Process Control

Date : 25.05.06

Time : 3 Hours

Max.Marks : 40 (40 %)

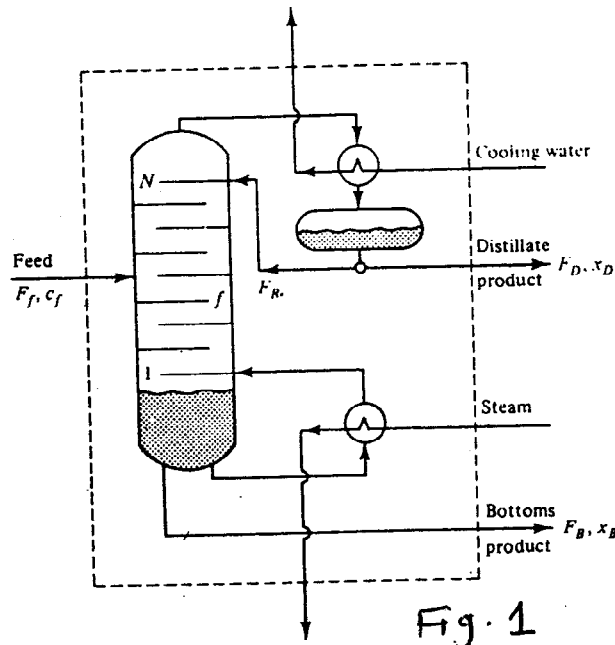
NOTE: 1. ANSWER ALL QUESTIONS IN SEQUENTIAL ORDER

2. ALL QUESTIONS CARRY 5 MARKS EACH.

3. GET SIGNED IN GRAPH SHEET BY THE INVIGILATOR BEFORE YOU  
WORKOUT.

(8\*5=40 Marks)

1. Find the Degrees of freedom for the binary distillation column shown below ( Fig 1).



2. Plot the bode diagram for the following transfer function.(Assume low frequency as 0.1rad/sec and High frequency as 10 rad/sec)

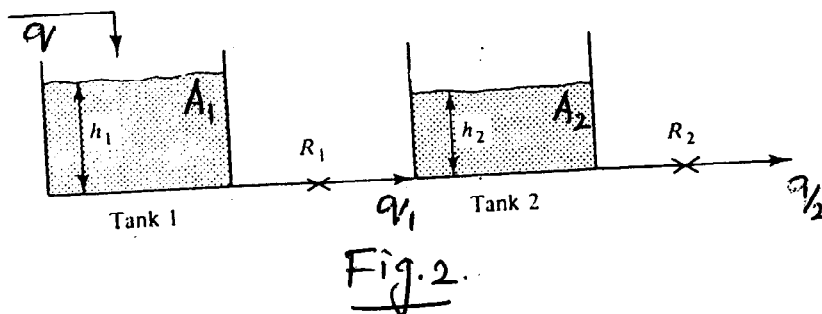
$$G(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$$

3. A unity feed back system has an open loop transfer function ,

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

Find (a) percent overshoot (b) peak overshoot (c) peak time, (d) settling time (e) decay ratio for a step input of 12 units.

4. Consider the tanks shown below (Fig 2). Find the over all transfer function.



5. Find the gain of the proportional controller that produces a closed loop response for second order with decay ratio equal to  $1/4$ . The process is described by

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

6. The open loop transfer of a unity feedback system is given by

$$G(s) = (1 + 0.2s)(1 + 0.025s) / s^3 (1 + 0.005s)(1 + 0.001s).$$

Sketch the polar plot and determine the phase margin.

7. Explain about the Ratio control and Split range control in detail.

8. A transient disturbance test is run on a process loop. The results of a 9% controlling variable change give a process -reaction graph as shown in Fig 3.

- a. Find the settings for three mode action
- b. Find the three mode settings for a quarter- amplitude response.

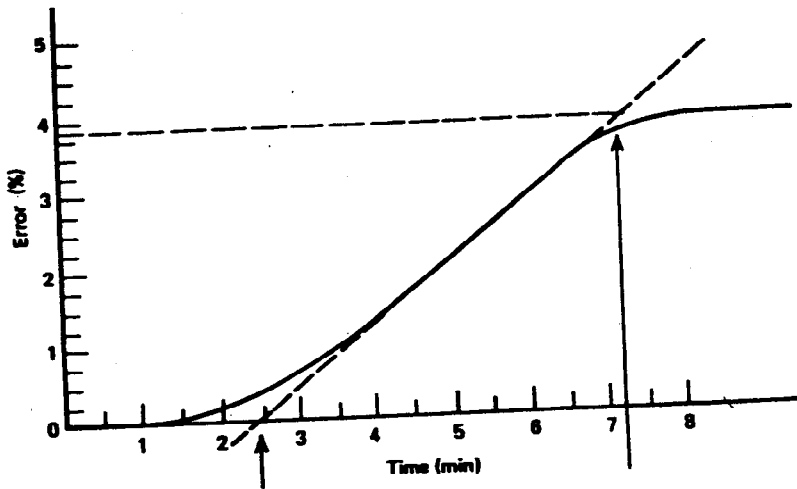


Fig. 3

***ALL THE BEST***

**BITS,PILANI- DUBAI CAMPUS**

**Knowledge Village, Dubai**

**Year IV– Semester II 2005 – 2006**

**TEST I (Closed Book)**

**Course No: INSTR UC451**

**Course Title: Process Control**

**Date:02.04.06**

**Time: 50 Minutes**

**M.M = 20(20%)**

**ANSWER ALL THE QUESTIONS**

**(4\*5=20)**

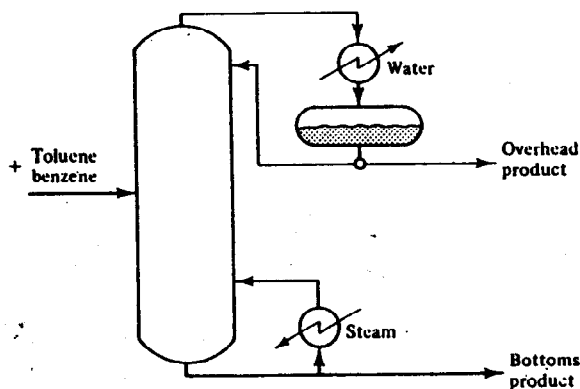
**1.In the figure shown , the distillation configuration for the separation of benzene from toluene is given. The feed to the distillation comes from the reactor, where toluene has been hydro dealkylated to produce benzene,**



**After the excess  $\text{H}_2$  and the produced  $\text{CH}_4$  have been removed in a flash unit.**

**For the distillation system:**

- d. Identify all the control objective**
- e. Identify all external disturbances.**
- f. All the available measurements and manipulated variables.**



*Fig.1*

2. Develop the mathematical model and Find the degrees of freedom for the Stirred tank heater shown below.

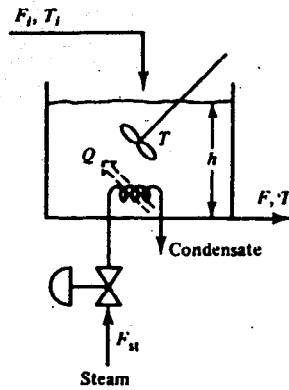


Fig. 2.

3. Consider a dynamic system described by two state variables  $x_1$  and  $x_2$  and the following state equation.

$$dx_1 / dt = f_1(x_1, x_2)$$

$$dx_2 / dt = f_2(x_1, x_2)$$

Find the linearized approximation of the non linear state equation in terms of deviation variables.

4. Find the linearized model of the system in terms of deviation variable for the figure shown below. Assume  $F_0 = \beta \sqrt{h}$ .

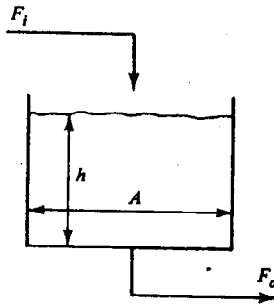


Fig 3

**BITS,PILANI- DUBAI CAMPUS**  
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**Year IV – Semester II 2005 – 2006**  
**QUIZ (Closed Book)**

**Course No: INSTR UC451**

**Course Title: Process control**

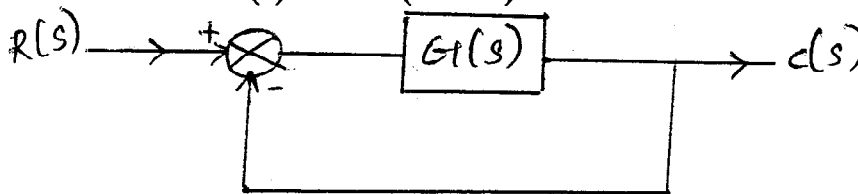
**Date:08.03.06**

**Time: 30 Minutes**

**M.M = 20(10%)**

**ANSWER ALL THE QUESTIONS**

**A. The unity feedback system is characterized by an open loop transfer function  $G(s) = K / s(s+100)$  .**



1. Determine the gain  $K$ , so that the system will have a damping ratio of 0.5 for this value of  $K$ . .....
2. The value of  $W_n$  is .....
3. The value of settling time for 2% error is .....
4. The value of peak overshoot 1s .....
5. The value of time to peak overshoot is .....

**B. Say true or False**

6. The tank with larger capacity has a smaller time constant. ....
7. Interacting capacities always results in Overdamped system .....
8. Interacting capacities are more sluggish than the non interacting. ....

9. A processing system with its controller may exhibit higher order dynamics.

.....

10. The larger the value of the time constant , the steeper the initial response of the system. ....

C.

11. Define interacting system.

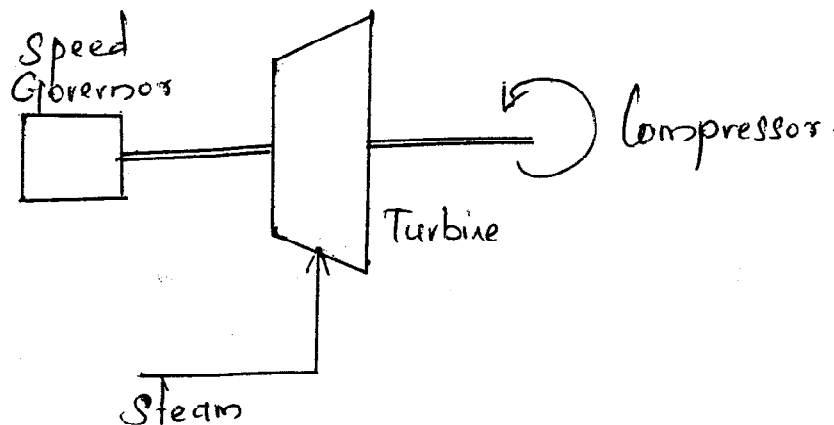
12. What do you mean by self regulating process?

13. What is the Equilibrium equation in binary Distillation column?

14. Mention the fundamental quantities to characterize a processing system.

15. Processes with dead time are difficult to control. Why?

D. A steam turbine drives a compressor whose load can change with time. Small variations in the shaft speed of the turbine are controlled through the use of a fly ball speed governor. For this system identify





16. The external disturbance are.....

17. The manipulated variables  
are.....

18. What is the basic control objective.....

19. Suggest a control feedback control system that can be used to satisfy the control  
objective. (2Marks)