230-425 Name_____ _____Code_____

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester I Academic year: 2004
Date: 5, October 2004 Time: 9.00-12.00
Subject: 230 – 425 Process Dynamics and Control Room : R 300

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- ข้อสอบมีทั้งหมด 5 ข้อ รวม 7 หน้า รวมปกให้นักศึกษาตรวจสอบความเรียบร้อย เขียนชื่อและรหัสทุกหน้าก่อนลงมือทำข้อสอบ

- อนุญาตให้นำกระดาษขนาด A4 จดบันทึกด้วยลายมือเข้าได้ 1 แผ่นเท่านั้น
- อนุญาตให้นำเครื่องคำนวณเข้าในห้องสอบได้
- อนุญาตให้ทำข้อสอบด้านหลังได้

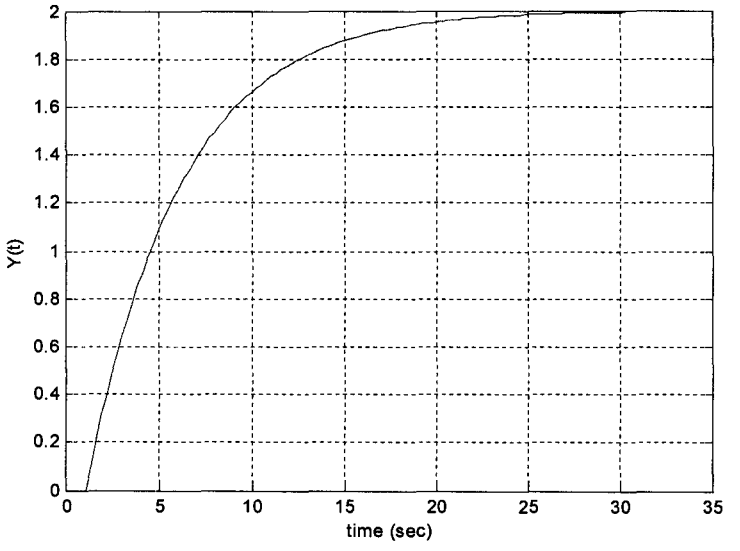
ข้อ	คะแนนเต็ม
1	10
2	10
3	10
4	30
5	120
รวม	160

อาจารย์กุลชนาฐ กปิลกาญจน์
ผู้ออกข้อสอบ

1 (10 points) Explain about "override control" and what is the situation that override control structure can be applied to the process.

2 (10 points) What are differences between "Sink" and "Source" in Matlab control Simulink? And show 2 examples of sink and 2 examples of source.

3 (10 points) One way to find transfer function of the process is to apply a unit step change and check the results. The figure below shows the result of a process test which disturbance input (x) is **a unit-step** function. Show the answers of each question from the figures:



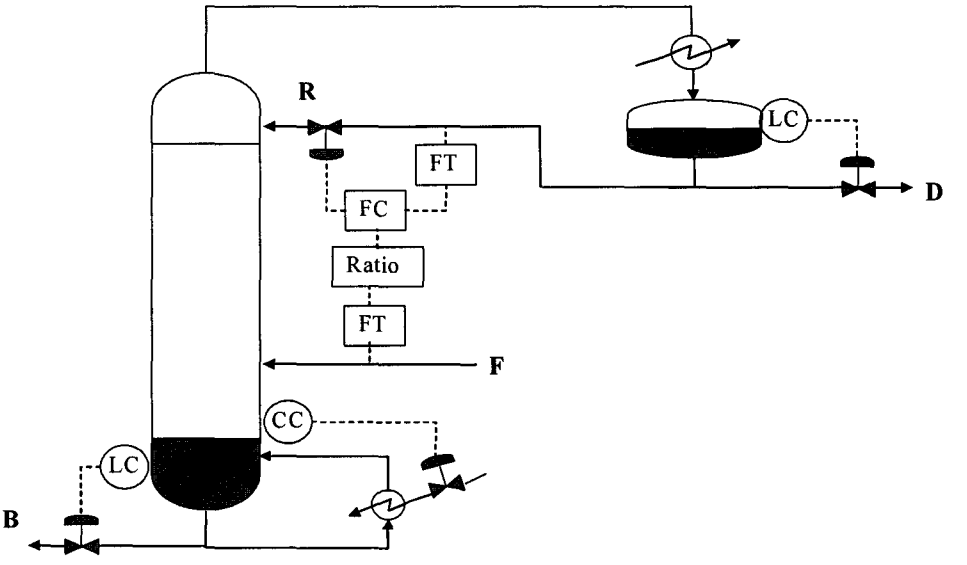
3.1 The system order is_____ 3.2 Dead-time =_____

3.3 Process steady-state gain = _____3.4 that can be found from_____

3.5 Process time constant =_____

Therefore the transfers function of this process is_____

4 (30 points) Control structure for distillation column is shown in the figure below. The solid lines represent the material streams and dash lines represent the transmitter lines. Letters "B", "D", "F" and "R" represent bottom, distillated, feed and reflux flow rates, respectively. Please answer the following questions:



4.1 Show the pairs of controlled variables and manipulated variables.

controlled variables **manipulated variable**

4.2 What is the external disturbance?

4.3 Where are feed forward and feedback controls in the process?

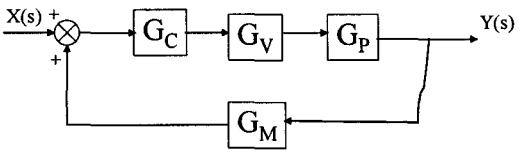
Feed forward

Feedback

4.4 How does the ratio control work?

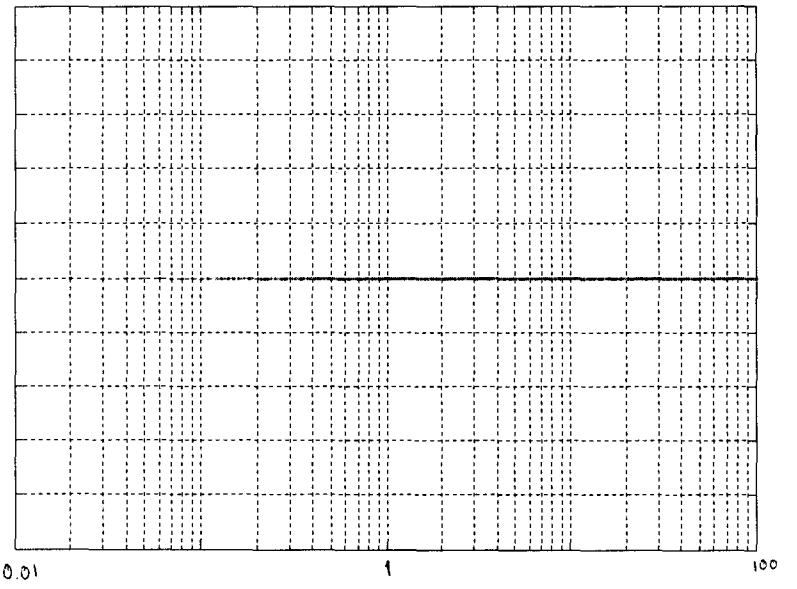
5 (120 points) Consider a process in the following figure whose transfer function is given by

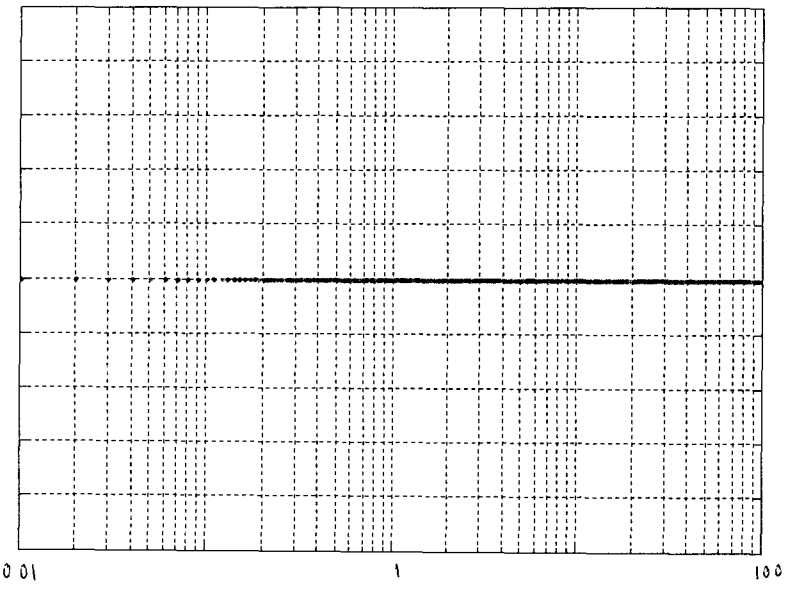
$$G_P(s) = \frac{1}{(s+1)(5s+1)}, G_M G_V = \frac{e^{-0.5s}}{(s+2)}$$



5.1 [20] Without considering dead time, calculate the value of gain for P controller by using Routh-Hurwitz stability criterion method.

5.2 [20] Roughly, sketch Bode diagram of this process transfer function (use AR/K_C).





5.3) [20] Calculate the value of K_U and ω_C for the system. (You can use the values from your sketch in 5.2 as an initial guess for trial-error).

5.4) [20] If P-controlled is used in the process, calculate K_C from phase margin of 45° and from gain margin of 1.7. Which is K_c that should be used in the process.

5.5) [40] Calculate the Ziegler-Nichols controller setting for the process with P, PI.and PID controllers. Then compare the amplitude ratios at -180° and phase at amplitude ratio, AR =1 of P and PI cases in the table.

Controllers / Parameters	P	PI	PID
K_C			
τ_I			
τ_D			
Compare AR at phase = -180°			-
ComparePhase at AR = 1			-