

**PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING**

Final Examination: Semester I
Date: 8 October 2005
Subject: 230 – 425 Process Dynamics and Control

Academic year: 2005
Time: 9.00-12.00
Room: A 401

ทฤษฎีในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาคการศึกษา

- There are 5 pages of the exam not include the cover page.
 - Write your name or at least your code on each page.
 - If need to write the answers on the back of each page, please identify the problem number.
 - Write explanations clearly and concisely will be your advantage.
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Name _____ Code _____

Problem Number	Score	
1	25	
2	30	
3	20	
4	105	
Total	180	

Dr. Kulchanat Kapilakarn

1. [25 points].

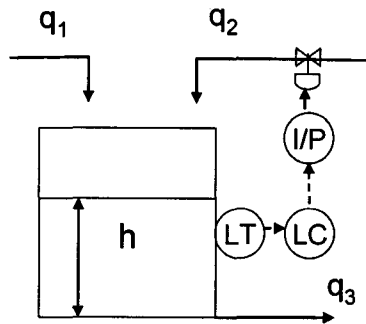


Figure 1.1

1.1 (5) From Figure 1.1 what are manipulated and external disturbance variables?

1.2 (20) Show a block diagram of a level control process from Figure 1.1 and transfer function for level of the tank (h).

2. [30 points]

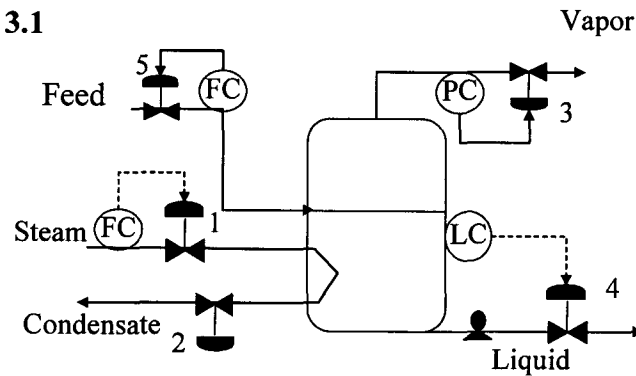
2.1 (15) Several linear transmitters have been installed and calibrated as shown in the table. Determine transmitter gains and develop an expression for the output of each transmitter as a function of its input

	Transmitter	Range	Transmitter gain	Expression
Flowrate	Pneumatic	400 gal/min → 15 psig 0 gal/min → 3 psig		
Pressure	Current	30 in Hg → 20 mA 10 in Hg → 4 mA		

2.2 (15) Give the details of “Ratio Control” and “Cascade Control”.

3. [20 points] A process instrumentation diagram of a flash drum is shown in Figure 3.1. Steam is condensed in a steam coil to vaporize a portion of the liquid feed, and the liquid product is removed by a pump. There are control valves for the steam flow, vapor product, liquid product, feed flow and the steam chest (which allows the steam chest to rapidly evacuate in emergency situations). For the safe operation, what are the action of each valve (air to close or air to open) and the action of the level controller (reverse or direct acting)? Giving some reasons of your answers is required.

Figure 3.1



4. [105 points] Let $G_C = k_C$, $G_V = \frac{1}{(4s+1)}$, $G_P = \frac{e^{-6s}}{(20s+1)}$ and $G_M = 5$

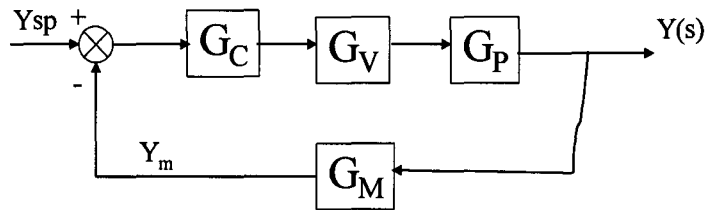


Figure 4.1

- 4.1. [12 points] Determine openloop and closed loop transfer functions (Y_m / Y_{SP}) of the process in Figure 4.1 And show characteristic equations.
- 4.2. [30 points] Determine ultimate gain k_C from Routh stability criterion by estimating dead time: $e^{-Ds} \approx (1-0.5Ds)/(1+0.5Ds)$
- 4.3. [28 points] Show the magnitude and phase angle of the system as a function of frequency and sketch Bode diagram.
- 4.4. [35 points] If G_C is transfer function of P controller, calculate k_C of the system which requires phase margin of 30° and gain margin of 1.7.