BITS PILANI , DUBAI CAMPUS
Dubai International Academic City, Dubai, UAE
Semester II 2013-2014
COMPREHENSIVE EXAMINATION (Closed Book)
BE (Hons) IV year EIE/ III CHEM

Course No : INSTR C451 / INSTR F342
Course Title : PROCESS CONTROL / PROCESS DYNAMICS & CONTROL
Date : 29.05.14 Time: 3Hours M.M = 80 (40%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Total No of Pages.2, No of Questions. 8
3. Answer all the questions sequentially

1. Find the total no of variables, total no of equations & the degrees of freedom for the binary distillation column shown in Figure 1 **[10M]**

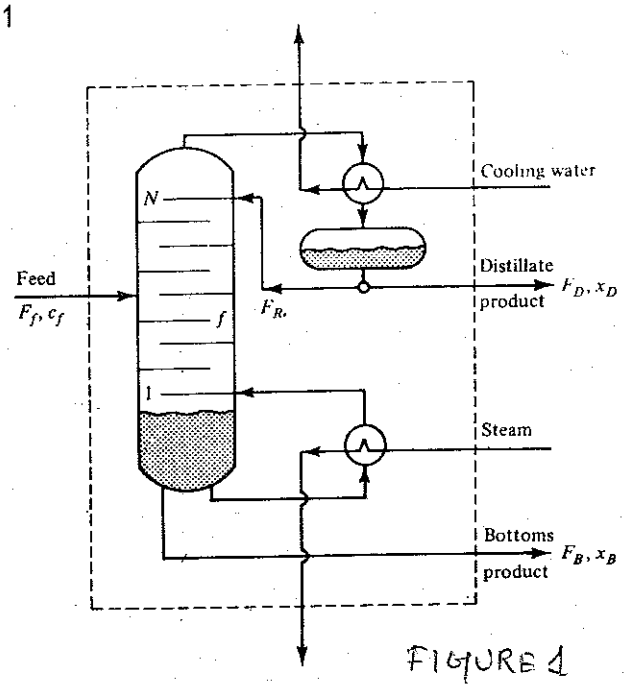

FIGURE 1

2 Consider the tanks shown in Figure 2.Find the over all transfer function for a unit step input. **[10M]**

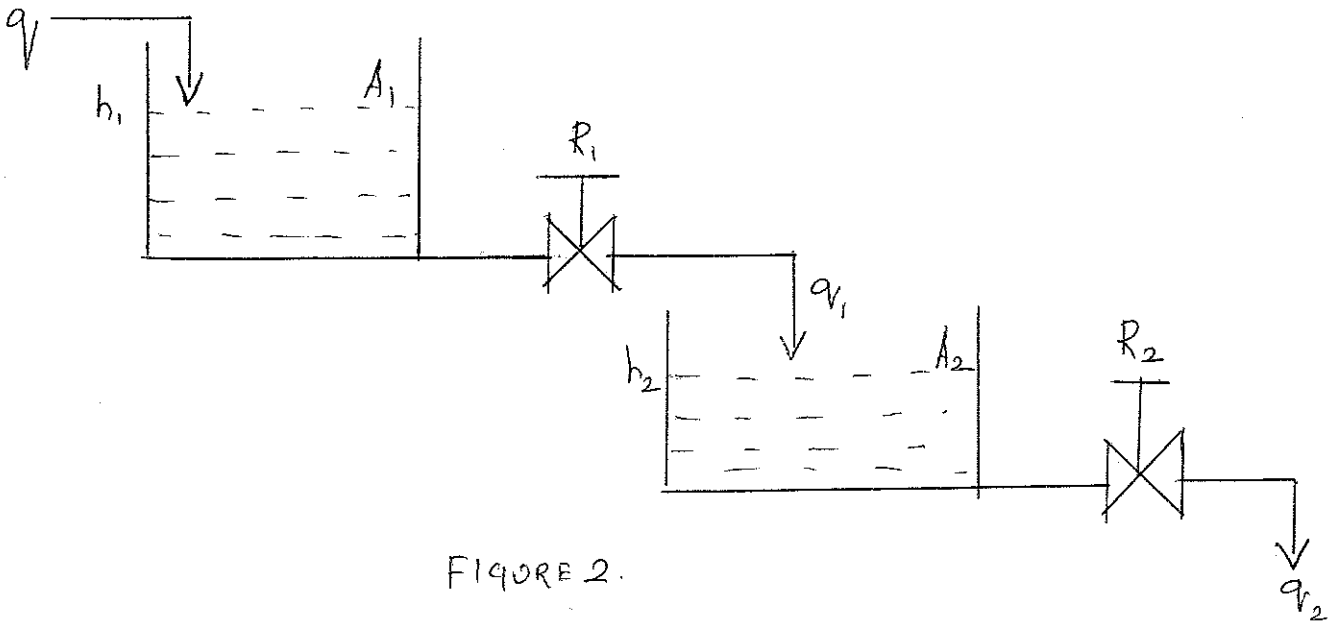

FIGURE 2.

3. Draw the root locus of a closed loop system with the following characteristics:

Process: $G_p(s) = \frac{K(s+1)}{s^2(s+5)}$,

Final control element: $G_f(s) = 1$ **[10M]**

4. Consider a process model which has the open loop transfer function with a unity feed back system

$G(s) = \frac{K}{s(1+0.5s)(1+5s)}$.

Sketch the polar plot in graph sheet and determine the phase margin & gain margin.
(Assume the frequencies as 0, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0, 10 rad/sec) **[10M]**

5. Draw the Bode plot (in the graph sheet) for the open loop transfer function with the following dynamic components:

$$G_p(s) = \frac{100}{s(1+0.2s)(1+0.02s)}; \quad G_f(s) = 1$$

and determine (1) gain cross over frequency (2) phase cross over frequency (3) Phase Margin (4) Gain margin. (Assume Lower frequency = 0.1 rad/ sec; Higher frequency = 100 rad/sec) **[10M]**

6. A step input of ' 3 ' is applied to a unity feedback system with $G(s) = \frac{6}{s(s+5)}$.

Find the response of the process control system. **[10M]**

7A. Under what condition we should select FFC + FBC system.
7B. What is meant by inferential complex control?
7C. Inverse response otherwise called as .....
7D. What is the response of pure capacitive process for the unit ramp input?
7E. For the second order system given below, if we introduce a unit step change in the input then what will be the percentage overshoot of the response? **[5*2=10M]**

$$G(s) = \frac{1}{s^2+s+1}$$

8A. The open loop transfer function of a unity feedback system is $G(s) = \frac{4}{s(s+1)}$

Determine the nature of the response of the closed loop system for a unit step input. Also determine the rise time, peak time, peak overshoot and settling times. **[5M]**

8B. The open loop transfer function of a unity feedback process control system is given by

$$G(s) = \frac{K}{s(1+as)(1+bs)}.$$

Derive an expression for the gain 'K' in terms of 'a' and 'b' for the stability of the system. **[5M]**

ALL THE BEST

BITS, PILANI – DUBAI
Dubai International Academic City, Dubai, UAE
Semester II 2013-2014
TEST II / (Open Book)
BE (Hons) IV year EIE / III CHEM

Course No : **INSTR C451 / INSTR F342**
Course Title : **PROCESS CONTROL / PROCESS DYNAMICS & CONTROL**
Date : **29.04.14** **Time: 50 Minutes** **M.M = 20 (20%)**

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.
3. Total No of questions 3

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

$$G(s) = \frac{K_c}{(s+2)(s+4)(s^2+6s+25)}$$

By applying the Routh criterion, discuss the stability of the closed loop system as function of k_c Determine the value of k_c which will cause sustained oscillation in the closed loop system? **[5M]**

2. Draw the root locus (in the graph sheet) of a closed loop system with the following characteristics:

Process: $G_p(s) = \frac{K(s+7)}{(s+2)(s+6)}$.

Final control element: $G_f(s) = 1$ **[8M]**

Give conclusion for the root locus branches.

3. Draw the Bode plot (in the graph sheet) for the open loop transfer function with the following dynamic components:

$$G_p(s) = \frac{5}{s(1+0.2s)(1+0.02s)} \quad ; \quad G_f(s) = 1$$

and determine (1) gain cross over frequency (2) phase cross over frequency.
(Assume Lower frequency = 0.1 rad/ sec; Higher frequency = 100 rad/sec) **[7M]**

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BITS, PILANI – DUBAI
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Semester II 2013-2014
QUIZ II / (Closed Book)
BE (Hons) IV year EIE / III CHEM

Course No : INSTR C451 / INSTR F342
Course Title : PROCESS CONTROL / PROCESS DYNAMICS & CONTROL
Date : 12.05.14 Time: 20 Minutes M.M = 10 (10%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.

1. Sketch the polar plot for G(s) = $\frac{1}{s(1+sT_1)(1+sT_2)}$ [2M]

2. Find the phase margin and gain margin for the polar plot shown. [2M]

3. What are the classifications of control value? [2M]

4. When the cascade control system will be ineffective? [1M]

5. Feed forward control system is used for making variations in minor load variables. Say true or False. [1M]

6. Mention any four major differences between FBC and FFC. [2M]

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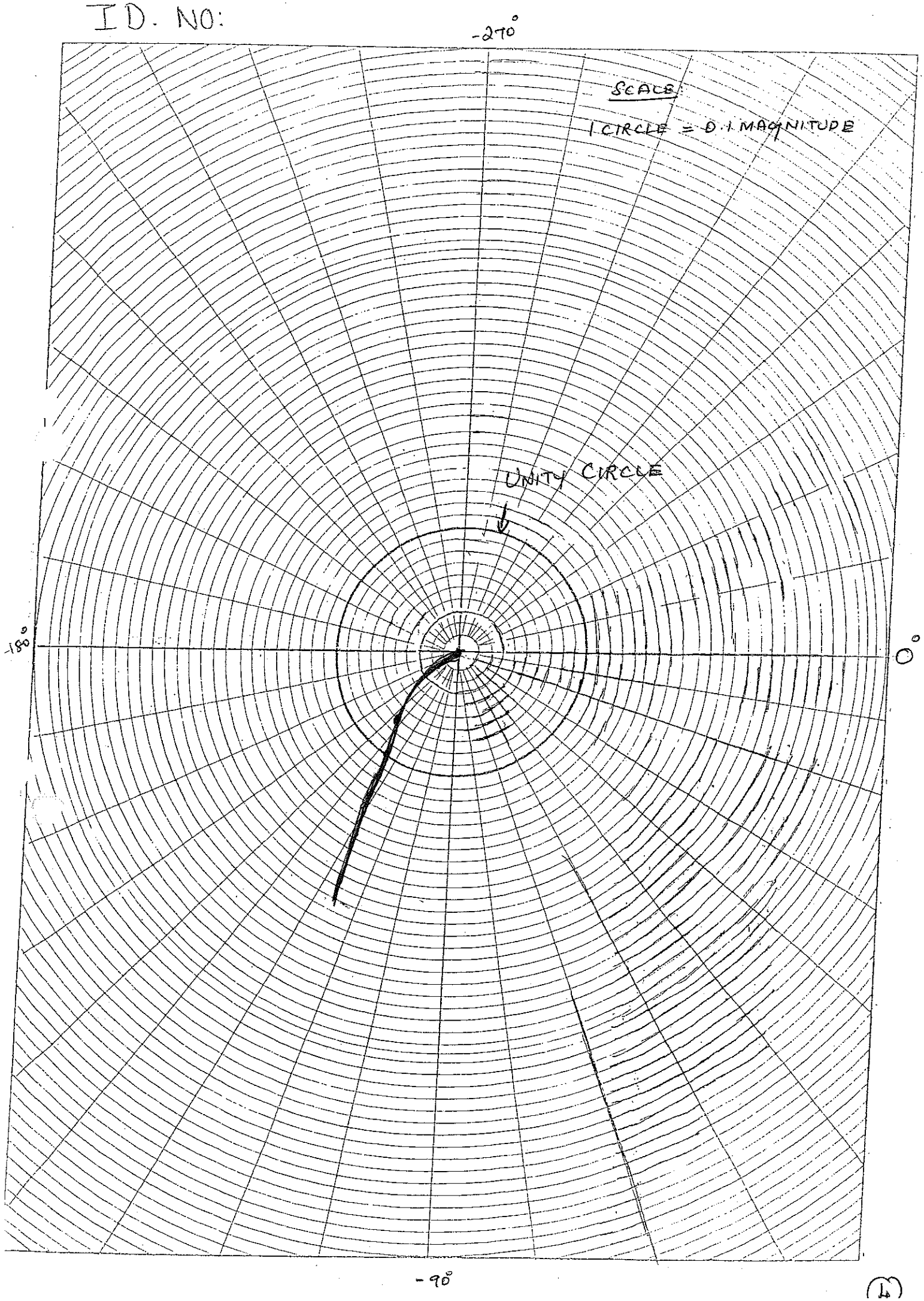

BITS, PILANI – DUBAI
Dubai International Academic City, Dubai, UAE
Semester II 2013-2014
TEST I / (Closed Book)
BE (Hons) IV year EIE / III CHEM

Course No : INSTR C451 / INSTR F342
Course Title : PROCESS CONTROL / PROCESS DYNAMICS & CONTROL
Date : 10.03.14 Time: 50 Minutes M.M = 20 (20%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.
3. Total No of questions 4

1. Derive the state equations and find the degree of freedom for the stirred tank heater shown in figure 1. [5M]

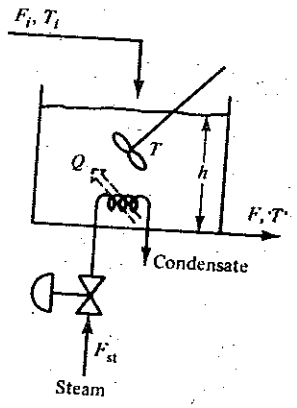

FIGURE 1

2. Find the response of first order system when subjected to a unit impulse input. [2M]

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3. Consider the unit step response of a unity feedback control system whose open loop transfer function is G(s) = $\frac{1}{s(s+1)}$. Obtain the rise time, peak time, maximum overshoot and settling time for 2%. [6M]

4. Consider the heat exchanger shown in figure 2. Identify: [7M]

a. The control objective for this system
b. All the external disturbances that will affect the operation of the exchanger.
c. All the available manipulated variables for the control of the exchanger in the presence of disturbances.
d. Construct two different feedback control configurations that will satisfy the control objective in the presence of disturbance.

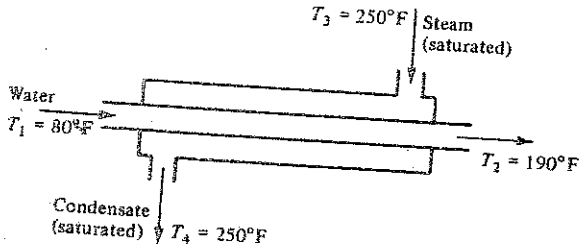

FIGURE 2

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