PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester 1 Academic Year: 2008
Date: July 29, 2008 Time: 9:00-12:00
Subject: 226-331: Industrial Automatic Control Room: A202

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions

- There are 6 questions in 4 pages.
- Attempt all questions; write the answer in the answer-book provided.
- A sheet of A4 notes (With your own hand-writing), and a calculator without programming capability are allowed.
- Total score is 100.

Name:	Student ID.....

Question #	Full Score	Assigned Score
1	**15**	
2	**20**	
3	**15**	
4	**15**	
5	**15**	
6	**20**	
Total	**100**	

Assoc. Prof. Somchai Chuchom

Name.....ID.....

Question #1 (15 marks)

Automatic control of water level using a float level was used in the Middle East for a water clock. The picture of the water clock was shown in Figure 1. Discuss the operation of the water clock, and establish how the float provides a feedback control that maintains the accuracy of the clock. Sketch a block diagram of the feedback system.

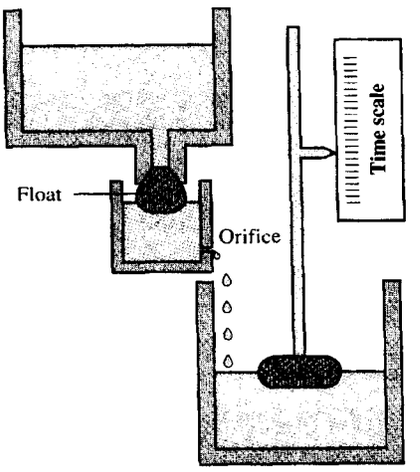

Figure 1 Water clock used in the Middle East

Question #2 (20 marks)

2.1 Solve the differential equation

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = 5e^{-2t} + t$$

Where $x(0) = 2;\quad \frac{dx(0)}{dt} = 1$

2.2 Solve the differential equation for Y(s)

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} - \frac{dy}{dt} + 6y = \frac{d^2x}{dt^2} - x$$

where y is the output; x is the input

with the initial conditions: $y(0^+) = \left.\frac{dy}{dt}\right|_{t=0^+} = 0;\quad \left.\frac{d^2y}{dt^2}\right|_{t=0^+} = 1$

Name.....ID.....

Question #3 (15 marks)

Determine the response, y(t), and its steady state response, $y(t)_{t\to\infty}$ of the system represented by the differential equation

$$\frac{d^2y}{dt^2}+4\frac{dy}{dt}+3y=2r(t)$$

where r(t) = 1, $t\geq 0$

with the initial conditions: y(0) =1, $\frac{dy(0)}{dt}=0$

Question #4 (15 marks)

Determine the transfer function, $T(s)=\frac{Y(s)}{R(s)}$, of the block diagram of the system shown in Figure 2.

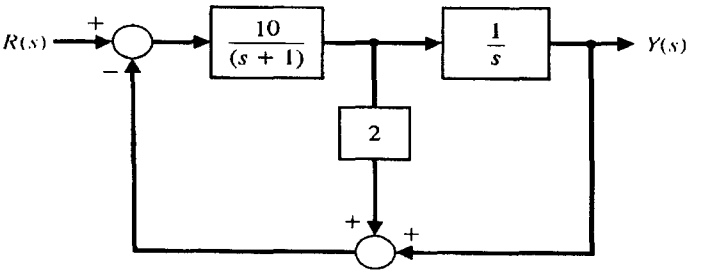

Figure 2

Question #5 (15 marks)

Given the mechanical system shown in Figure 3.

5.1 Draw the Grounded-Chair diagram for the system.

5.2 Determine the relationship between f and x.

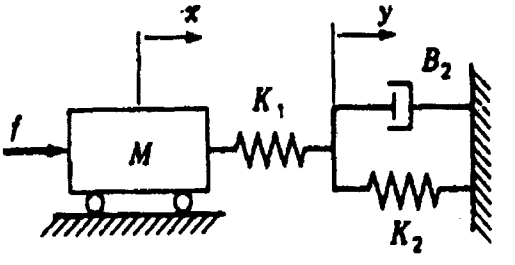

Figure 3

Question #6 (20 marks)

6.1 Explain why the PID controller gains wide acceptance.

6.2 Draw a block diagram of the pneumatic controller shown in Figure 4, and determine its Transfer Function. Also specify what control action it is.

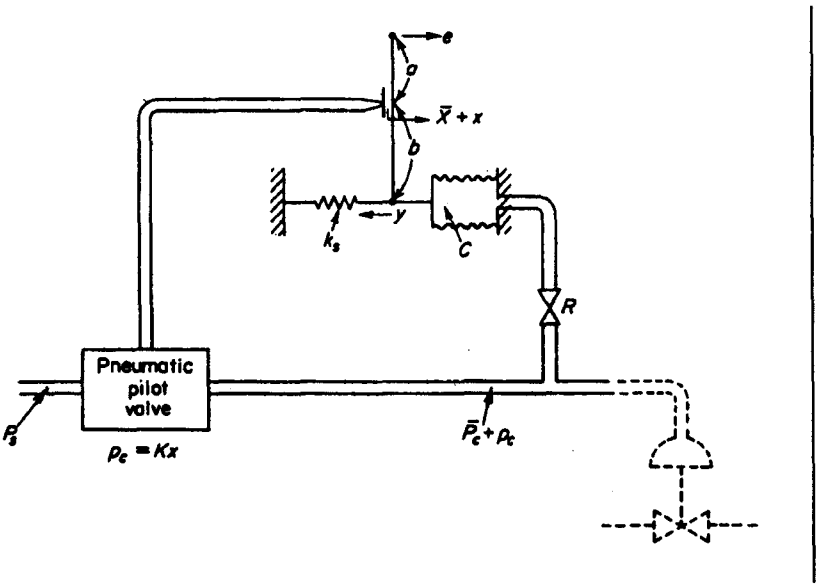

Figure 4