PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester 2 Academic Year: 2007
Date: December 26, 2007 Time: 13:30-16:30
Subject: 226-331: Industrial Automatic Control Room: R300

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions

- There are 7 questions in 11 pages.
- Attempt all questions and write the answer in this exam paper.
- A sheet of A4 notes (With your own hand-writing), a dictionary (**not** a talking dictionary) and a calculator without programming capability are allowed.
- Total score is 110.

Name:	Student ID.....

Question #	Full Score	Assigned Score
1	**20**	
2	**20**	
3	**10**	
4	**20**	
5	**10**	
6	**20**	
7	**10**	
Total	**110**	

Assoc. Prof. Somchai Chuchom

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

Question #1 (20 marks) Briefly explain the following questions.

1.1 Why is an automatic control system important in a manufacturing industry?

.....

.....

.....

1.2 The differences between the Command variable, v, and the Reference variable, r, are : .....

.....

.....

1.3 Give two examples of feedback control systems in which a human acts as a controller.

1).....

2).....

1.4 For the air-conditioning control system, list 2 parameters (also specify its type) and 2 variables (also specify its type) involved in the system.

Parameters		**Variables**	
name	**type**	**name**	**type**
1		1	
2		2	

1.5 In the past, control system used a human operator as part of a closed-loop control system. Sketch the block diagram of the valve control system shown in Figure 1.

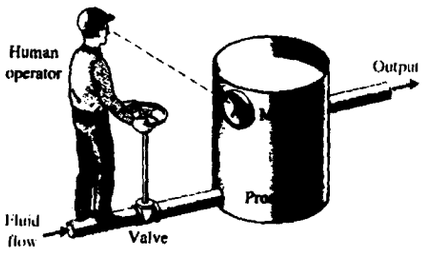

Figure 1

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

Question #2 (20 marks)

2a) Determine the output transform, Y(s), for the differential equations.

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

where y is output, and initial conditions are: $y(0^+)=\left.\frac{dy}{dt}\right|_{t=0^+}=0$,

$\left.\frac{d^2y}{dt^2}\right|_{t=0^+}=1$, x is input and $x(t) = 5 \sin t$.

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

2b) Determine $y(t)$ for the system described by the differential equation $\frac{d^2y}{dt^2}+3\frac{dy}{dt}+2y=\frac{dx}{dt}+3x$ with initial conditions $y(0^+)=1,\ \left.\frac{dy}{dt}\right|_{t=0^+}=0$ and the input is given by $x(t)=e^{-4t}$

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Question #3 (10 marks)

A two-mass model of the robot is shown in Figure 3. Find the transfer function, G(s) = Y(s)/F(s).

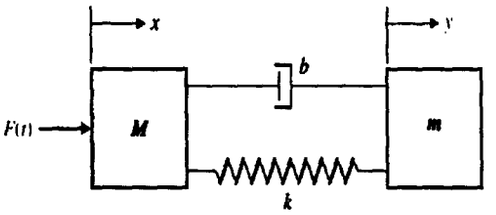


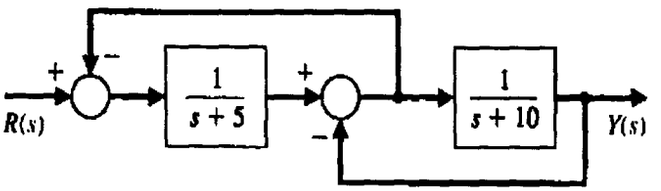
Figure 3

Question #4 (20 marks)

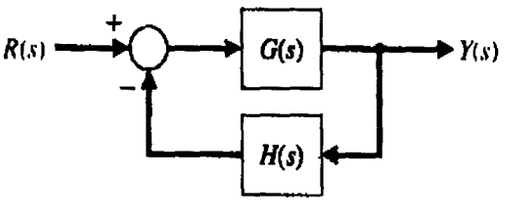
A system is shown in Figure 4 (a).

4.1) Determine G(s) and H(s) of the block diagram shown in Figure 4(b) that are equivalent to those of the block diagram of Figure 4(a).

4.2) Determine Y(s)/R(s).



(a)



(b)

Figure 4

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

Question #5 (10 marks).

Simplify the block diagram of the system shown in Figure 5.

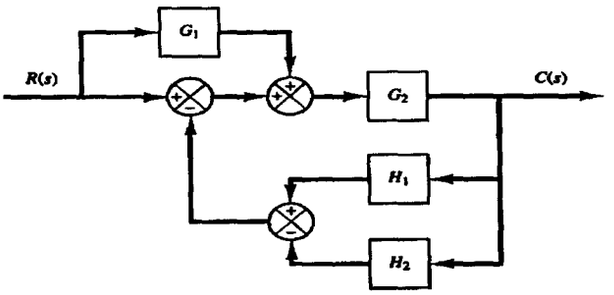


Figure 5

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

Question #6 (20 marks).

A system is shown in Figure 6

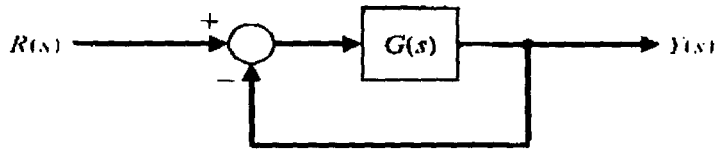


Figure 6

6.1) Find the closed-loop transfer function Y(s)/R(s) when

$$G(s) = \frac{10}{s^2 + 2s + 10}$$

6.2) Determine Y(s) when the input R(s) is a unit step.

6.3) Compute y(t).

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

Question #7 (10 marks).

Given the control system as shown in Figure 7, determine an appropriate gain, K, so that the steady-state error to a unit step input is minimized.

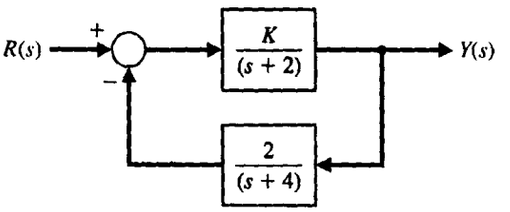


Figure 7