PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester 1 Academic Year: 2009
Date: August 2, 2009 Time: 9:00-12:00
Subject: 226-433: Industrial Automatic Control Room: หัวหุ่นยนต์

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions

- There are 6 questions in 9 pages.
- Attempt all questions and write the answer in this exam paper.
- All notes, books and calculators are allowed. (Open-book exams)
- Total score is 75.

Name:	Student ID.....

Question #	Full Score	Assigned Score
1	**20**	
2	**15**	
3	**10**	
4	**10**	
5	**10**	
6	**10**	
Total	**75**	

Assoc. Prof. Somchai Chuchom

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

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

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

.....
.....
.....
.....
.....

1.2 The differences between the Manipulating variable, m, and the Controlled variable, c, are : .....

.....
.....
.....

1.3 For the automatic-door control system, list 3 parameters (also specify its type) and 3 variables (also specify its type) involved in the system

Parameters		Variables	
name	type	name	type
1		1	
2		2	
3		3	

1.4 For each one of the following systems, argue if in your opinion it is open-loop or closed-loop. In your argument, include your definitions of system inputs and outputs. Briefly describe how feedback is effected in the systems which you decide are closed-loop.

a) A Washing machine.
b) A traffic light control at the junction.
c) Audio speaker.
d) Power-amplified handwheel of the automobile

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

Question #2 (15 marks)

2a) Solve the following differential equations *using classical methods*.

$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + x = 5u(t)$; Assume zero initial conditions

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

2b) Using the Laplace transform technique, find the forced response of the differential equation

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = 3\frac{dx}{dt} + 2x \qquad \text{;where } x(t) = e^{-3t},\ t\rangle 0$$

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

Question #3 (10 marks)

An example of a belt drive printer with DC motor actuator is shown in Figure 1. In this model, a light sensor is used to measure the position of the printing device, and the belt tension adjusts the spring flexibility of the belt. The goal of the design is to determine the effect of the belt spring constant k and select the appropriate parameters for the motor, the belt pulley, and the controller. Propose the model for controlling the position of the printing device, and specify the (appropriate) transfer function for the system.

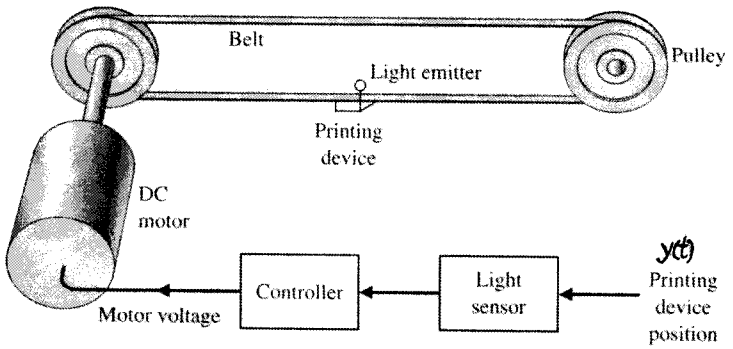

Figure 1

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

Question #4 (10 marks)

Determine the transfer function of the system in Figure 2

4a) Y(s)/R(s)

4b) Y(s)/D(s)

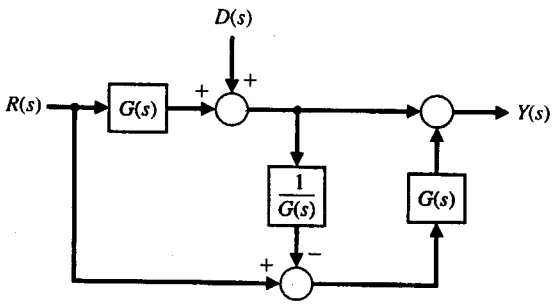

Figure 2

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

Question #5 (10 marks)
Find the response *v(t)* of the mass element shown in Figure 3 to a unit step the applied force *F(t)*. Suppose that *m* is 1 kg and *B* is 0.2 kg/m/s, calculate the response *v(t)*.

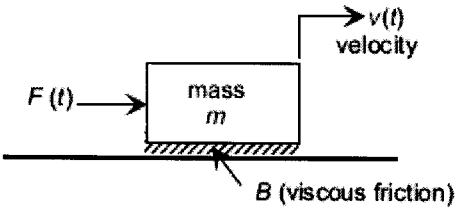

Figure 3

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

Question #6 (10 marks)

A dynamic vibration absorber is shown in Figure 4. The parameters M_2 and k_{12} may be chosen so that the main mass M_1 does not vibrate in the steady state when $F(t) = a \sin \omega_0 t$. Obtain the differential equations describing the system.

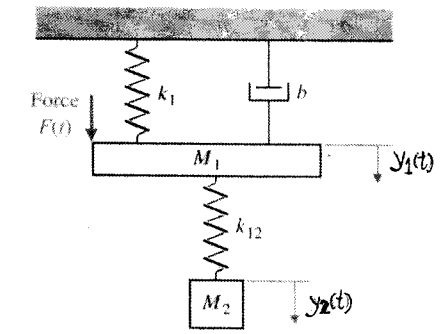

Figure 4