

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination : Semester 2

Academic Year : 2004

Date : 21st December, 2004

Time : 9.00-12.00

Subject : 226-331 Industrial Automation

Room : R300

Direction

- There are 2 parts, Part A and Part B for the exam.
- There are 4 questions for Part A. The total score is 30.
- There are 6 questions for Part B. The total score is 30.
- All materials, books, calculators are allowed.

Empaper

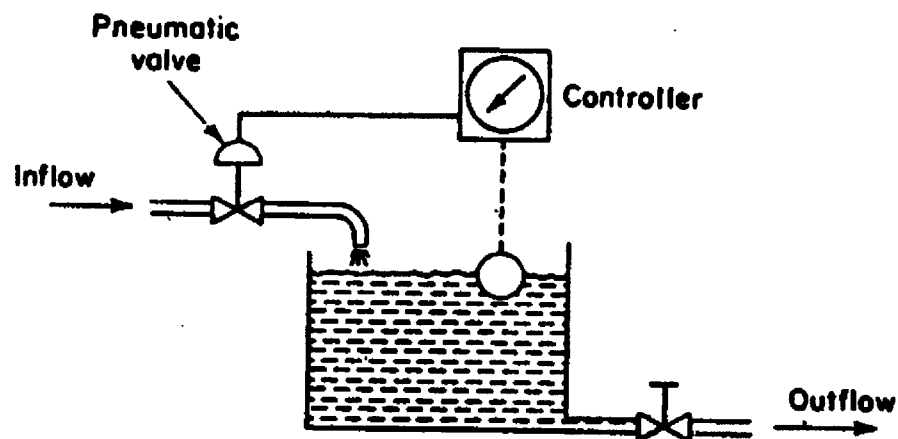
PART A: Control Theory

Question	Full score	Assigned score
1	5	
2	10	
3	7	
4	8	
Total	30	

Asst. Prof. Somchai Chuchom

NameID

Question 1 Explain how the control system below works, also identify its Input, Output, and specify the type of the control system. (5 marks)



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Question 2 The system described by the differential equation

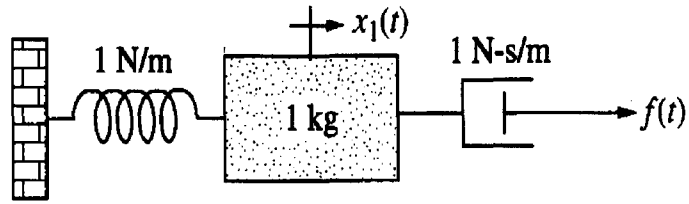
$$d^2y/dt^2 + 3dy/dt + 2y = dx/dt + 3x$$

with initial conditions $y(0^+) = 1$; and $dy/dt|_{t=0^+} = 0$

If the input is given by $x(t) = e^{-4t}$, Find the following:

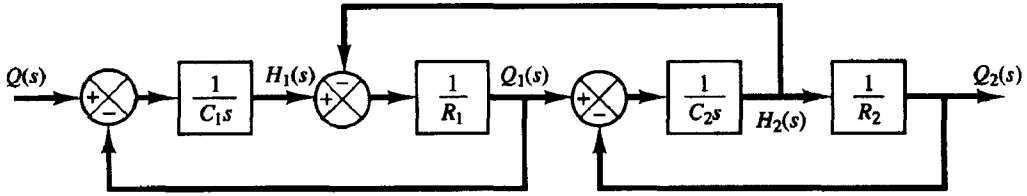
- a) $Y(s)$; (5marks)
- b) $y(t)$. (5marks)

Question 3 Find the transfer function, $G(s) = X_1(s)/F(s)$, for the translational mechanical system shown below. (7 marks)

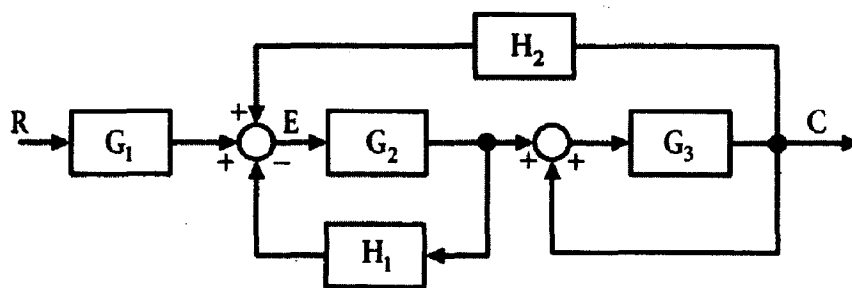


Question 4 Simplify the following block diagrams.

4-1 (4 marks)



4-2 (4 marks)



PART B**Assist. Prof. Wanida Rattanamanee**

Name.....Code.....

ข้อ	คะแนนเต็ม	คะแนนที่ได้
1	4	
2	6	
3	4	
4	4	
5	6	
6	6	
รวม	30	

1. What are the meaning of input and output of the automatic systems? (4 points)

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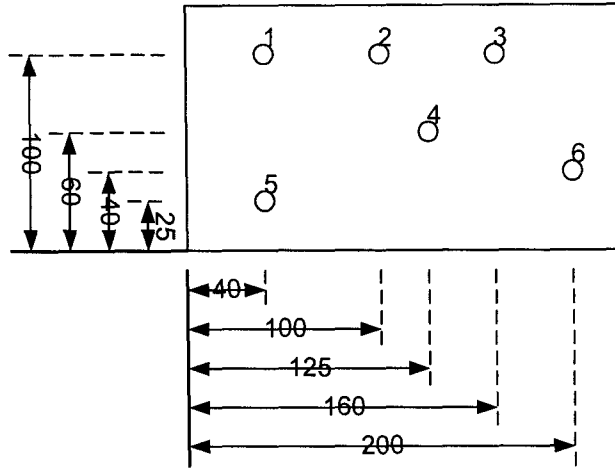
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2. An NC drill press drills four 10.0 mm. diameter holes at four locations on a flat aluminum plate in a production work cycle. Although the plate is only 12 mm. thick, the drill must travel a full 20 mm. vertically at each hole location to allow for clearance above the plate and breakthrough of the drill on the underside of the plate. Cutting conditions : speed = 0.4 m/sec. and feed = 0.10 mm./rev. Hole locations are indicated in the following table: (6 points)

Hole number	X-coordinate (mm)	Y-coordinate(mm)
1	25.0	25.0
2	25.0	100.0
3	100.0	100.0
4	100.0	25.0

The drill starts out at point (0,0) and returns to the same position after the work cycle is completed. Travel rate of the table in moving from one coordinate position to another is 500 mm/min. Assume that all moves are made to minimize the total cycle time. If loading and unloading the plate take 20 sec. (total handling time), determine the time required for the work cycle.

3. From the picture, write down the corresponding X and Y axis dimensions in an NC part program by using incremental positioning and absolute positioning systems? Start point is (0,0). (4 points)



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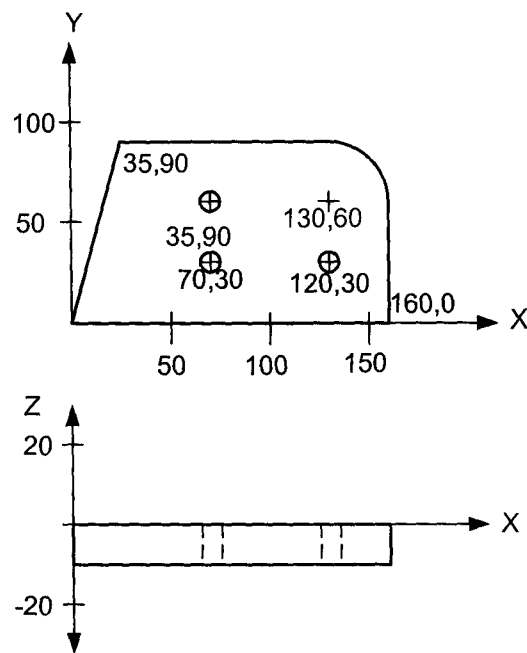
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- 4. Define accuracy and repeatability of the CNC machine system. (4 points)

- 5. A dc servomotor is used to drive the x axis of a NC milling machine table. The motor is coupled directly to the table leadscrew, which has 4 threads/in. An optical encoder is used to provide the feedback measurement. It is connected to the leadscrew using a 1 : 5 gear ratio (1 turn of the leadscrew converts to 5 turns of the encoder disk. The optical encoder emits 125 pulses per revolution. To execute a certain programmed instruction, the table must be moved from point (3.5, 1.5) to point (1.0,7.2) in a straight-line trajectory at a feed rate of 7.5 in./min. Determine (a) the number of feedback pulses for the x axis, (b) the rotational speed of the motor, and (c) the pulse rate (6 points)

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6. From the picture, this problem presents the NC part program in word address format for drilling the three holes (@ 7.0 mm. dia.) in the sample part shown in the picture. We assume that the outside edges of the starting workpart have been rough cut (by jig sawing). For the present drilling sequence, the part is gripped in place so that its top surface is 40 mm. above the surface of the machine tool table. The drill will be operated at a feed of 0.05 mm/rev. and spindle speed of 1000 rev / min. At the beginning of the job, the drill point will be positioned at a target point located at x=0 y=-50 and z=10 (axis units are mm.). The program begins with the tool positioned at this target point. (6 points)



Fill the answers in the blank

NC Part Program Code

N001 G21 G... G92 X0 Y-050.0 Z010.0	N007 G01 Z010.0
N002 G00 X070.0 Y030.0	N008 G... X..... Y.....
N003 G01 G95 Z..... F..... S..... M03	N009 G01 G95 Z..... F.....
N004 G01 Z010.0	N010 G01 Z010.0
N005 G..... Y.....	N011 G00 X0 Y-50.0 M05
N006 G01 G95 Z..... F.....	N012 M.....

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