Prince of Songkla University

Faculty of Engineering

Final Examination : Semester II   **Academic Year : 2004**

Date : February 26, 2005.   **Time : 09.00-12.00**

Subject : 226-331 Industrial Automation   **Room : R200, R201**

Directions :

- There are 2 parts, Part A and Part B for the exam.

- There are 5 questions for Part A. The total score is 40.

- There are 5 questions for Part B. The total score is 40.

- All stuff (such as books, sheets, etc.) **are not allowed** to the exam room.

- An un-programmable calculator (Fx 5500 or lower) is allowed.

- Dictionary **can not** be taken to the exam room.

- Write your solutions on the exam paper.

ทุจริตในการสอบ โทษขั้นต่ำปรับตกในรายวิชานั้น
และพักการเรียน 1 ภาคการศึกษา

Asst. Prof. Somchai Chuchom

Asst. Prof. Wanida Rattanamanee

PART A: Control Theory

Question	Full score	Assigned score
1	10	
2	5	
3	7	
4	8	
5	10	
Total	*40*	

Asst. Prof. Somchai Chuchom

Name ....ID

Question #1

1.1 Specify the advantages and disadvantages of the proportional controllers, the integral controllers, and the proportional-plus-derivative controllers. (3 marks)

1.2 Determine whether the control system with the closed-loop transfer function below is stable or not, show how to reach the solution. (3 marks)

$$T(s) = \frac{10}{s^5+7s^4+6s^3+42s^2+8s+56}$$

1.3 Determine whether the system with the block diagram shown
below is stable or not, show how to reach the solution.
(4 marks)
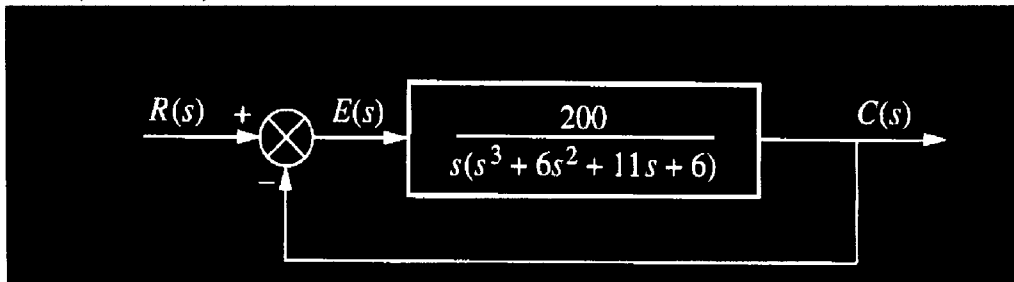
Question #2 Find the range of K to keep the system shown below stable.
(5 marks)
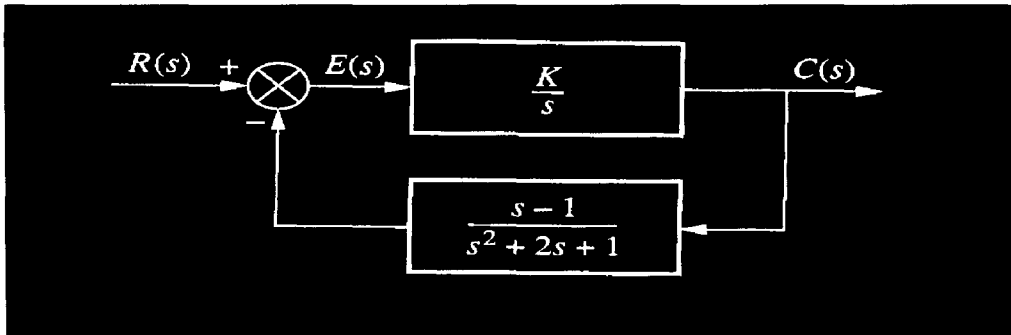
Question #3 For the unity feedback system of the system below,
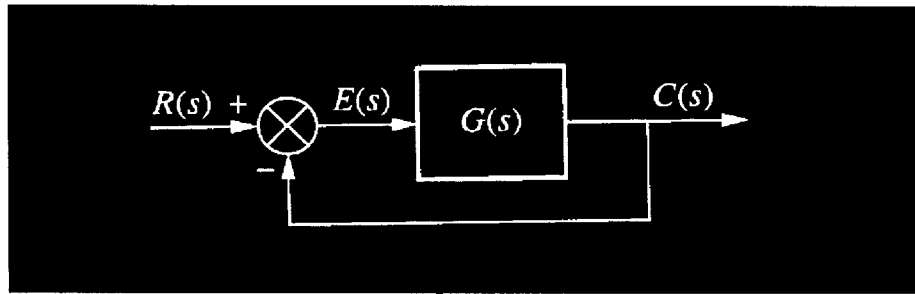
$$G(s) \quad = \quad \frac{K(s^2+2s+5)}{(s+2)^2(s+3)}$$

3.1 Find the system type. (2 marks)
3.2 What error can be expected for an input of *10 u(t)* ?
     (5 marks)

Question #4 For each of the root loci shown in Figure 4-1, tell whether or not the sketch can be a root locus. If it cannot be a root locus, explain why, give all reasons. (8 marks)

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)
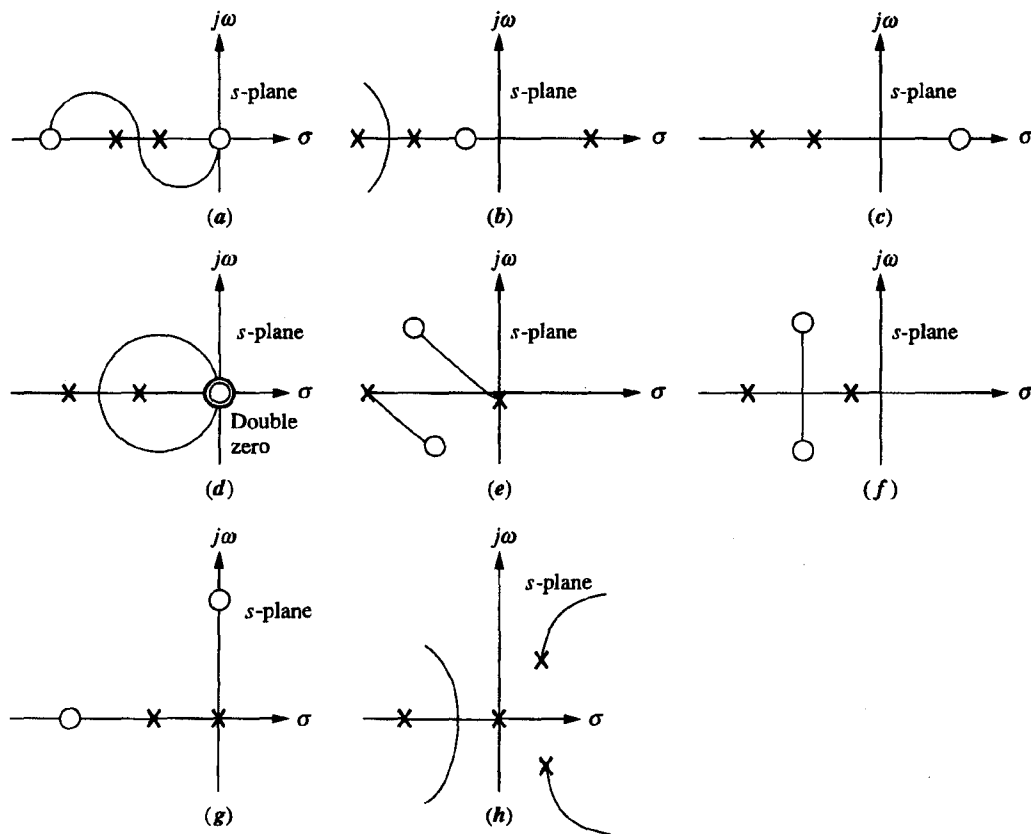
Figure 4-1

Question #5 (10 marks) Construct the root-locus for *K>0* of the system with the open-loop transfer function

$$G(s)H(s) = \frac{K}{s(s+1)(s+3)(s+4)}$$

PART B

Asst. Prof. Wanida Rattanamanee

| Question	Full Scores	Taken Scores
1	10	
2	7	
3	8	
4	9	
5	6	
Total	**40**	

1. In the para-wood furniture manufacturing, there are many processes which are recieving the rubber-wood, cutting to the pieces of wood, vacuuming the lumber, drying the vacuumed lumber, shaping the lumber, assembling to the furniture and packaging. From these processes, you have to design the automated material handling system for the factory. In general, the para-wood furniture manufacturing is kind of job-shop system (the process layout).

   1.1 Which are the factors affected the automated material handling system? Explain how they affect the system. (**5 points**)

   1.2 What kind of automated material equipment for the system? Explain how they can work the system. (**5 points**)

………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………

2. A robot performs loading and unloading operations for a machine tool. The work cycle consists of the following sequence of activities :

Seq.	Activity	Time (s.)
1	Robot reaches and picks part from incoming conveyor and loads into fixture on machine tool.	5.5
2	Machining cycle (automatic).	33.0
3	Robot reaches in, retrieves part from machine tool, and deposits it onto outgoing conveyor.	4.8
4	Move back to pickup position	1.7

The activities are performed sequentially as listed. Every 30 workparts, the cutting tools in the machine must be changed. This cycle takes 3.0 min. to accomplish. The maximum efficiency of the robot is 97%; and the maximum efficiency of the machine tool is 98%, not including interruptions for tool changes. These two efficiencies are assumed not to overlap (i.e., if the robot breaks down, the cell will stop to operate, so the machine tool will not have the opportunity to break down; and vice versa). Determine the hourly production rate. (7 points)

3. In a factory, there are 3 products manufactured in the factory. There are 5 workstations or processes located in the factory areas. The processes used to make the products and the product volumes per day are shown in Table 1. Uni-directional layout of workstations is shown in Figure 1. The manufacturer desires to develop the AGV's layout to reduce the total distance of transportation. Design and draw a new layout for the system and show what is difference from the original layout and show your method used to develop the new layout. Define 1 trip of AGV for 100 kg. (**8 points**)

Table 1 Show the processes and volumes per day for each product

Product Type	The workstation schedule	Volumes per day (kg.)
1	1→ 3 → 4 → 5	3,000
2	1 → 2 → 3 → 4	2,000
3	1 → 2 → 3 → 4 → 5	1,500

○ = Pick up and drop off point of each station
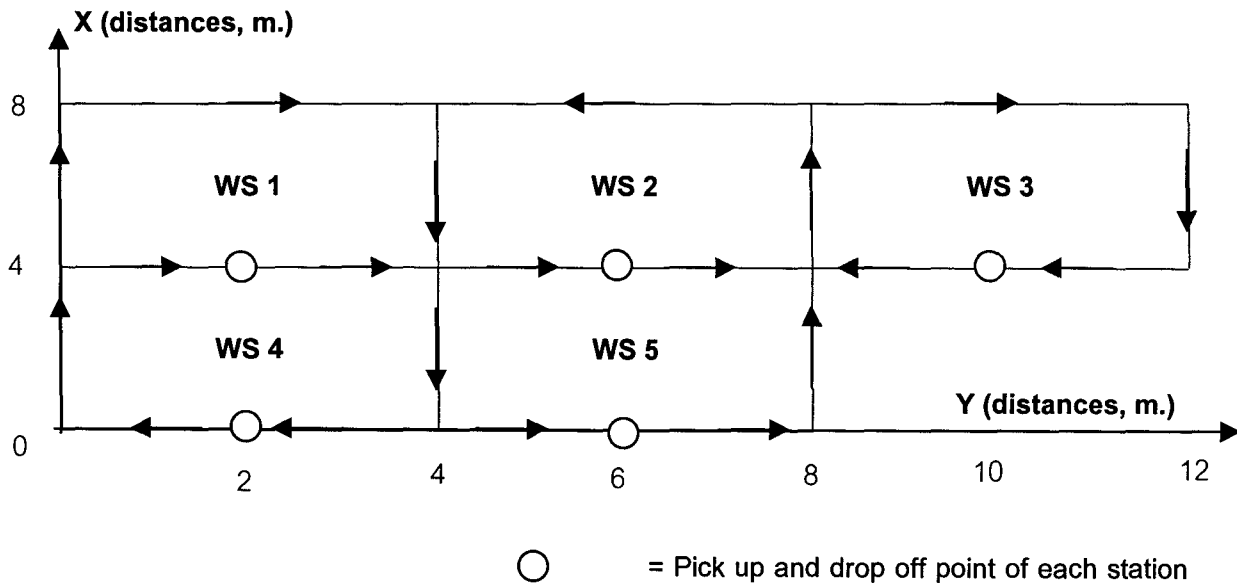
Figure 1 Uni-directional layout of the workstations

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

4. What is the flexible manufacturing system (FMS) and how can FMS be applied to the Tuna Canning factory? There are many processes which are selecting the good fish, cleaning, boiling, taking fish from their bone, and filling them to the can. (**9 points**)

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

5   Explain the definition and application of the follows ? (**6 points**)

    5.1 Serpentine

    5.2 Telelift Unicar

    5.3 HyBot^{TM}

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