Name _____ Student ID _____

Prince of Songkla University
Department of Industrial Engineering, Faculty of Engineering

Final Examination: Semester 2 Academic Year: 2005
Date: 23 February 2006 Time: 13:30-16:30
Subject: 226-502 Product Design and Management Room: R300

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียนหนึ่งภาคการศึกษา

Instructions: Read carefully

1. All materials are allowed.
2. There are 2 sections for this test. Section 1 has 4 problems. Do all of them. Also show your work clearly and legibly.
3. Answer the questions in this test paper, only.
4. You must write your name and your student ID in every page of the test.
5. Total score is 100 points.

Section 1: Nikorn Sirivongpaisal

Distribution of Score

Section	Problem	Points	Points Gained
1	1	5	
	2	5	
	3	5	
	4	25	

Tests are prepared by
Nikorn Sirivongpaisal

Name _____ Student ID _____

Problem 1: (5 points) Explain the relationship between "Business management" and "Quality".

Problem 2: (5 points) "It is a tragedy that, in the West, relations between … buyer and seller have been confrontational and adversarial …. It is not uncommon for a supplier with a history of loyal service to be unceremoniously dumped when the buyer finds another supplier selling more cheaply. Nor is it uncommon for a supplier to gouge a customer during a sellers' market and boom time …. In the long haul, this win-lose philosophy can turn both sides into losers (K.R. Bhote 1987)." Do you agree with this quotation? If you agree, explain, why.

Name _____ Student ID _____

Problem 3: (5 points) Explain the concept of design for logistics.

Problem 4: (25 points) Suppose that a manufacturer of men's shirts can produce a dress shirt in its Houston, Texas, plant for $8 per shirt (including the cost of raw materials). Chicago is a major market for 100,000 shirts per year. The shirt is priced at $15 at Chicago. Transportation and storage charges from Houston to Chicago amount to $5 per hundredweight. Each packaged shirt weighs 1 lb.

As an alternative, the company can have the shirts produced in Taiwan for $4 per shirt (including the cost of raw materials). The raw materials, weighing about 1 lb. per shirt, would be shipped from Houston to Taiwan at a cost of $2 per hundredweight. When the shirts are completed, they are to be shipped directly to Chicago at transportation and storage cost of $6 per hundredweight. An import duty of $0.50 per shirt is assessed.

From a total systemwide costs point of view, should the shirts be produced in Taiwan? **Note:** hundredweight is equal 100 lbs.

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ทุจริตในการสอบ โทษขั้นต่ำปรับตกในรายวิชานั้น และพักการเรียน 1 ภาคการศึกษา โทษสูงสุดให้ออก

Instruction

1. **Section II** , 6 questions , 80 points.
2. Attempt to do all questions in test paper. If it isn't enough, you can use other blank pages.
3. Books, sheets of paper note ,a dictionary and a calculator are allowed.
4. Don't write in red pen.

No.	Full Score	Score
1	10	
2	10	
3	10	
4	20	
5	15	
6	15	
Total	**80**	

Relaxation will make you have a good dream

Asst. Prof. Pichet Trakarnchaisiri

The goodwill engineering company has planed to design a new product, the automatic can crusher.

Question 1 If you were the one of designer team, could you recommend the 5 steps of identifying customer needs and give short explain in each step. (10 points)

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2. .....
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4. .....
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5. .....
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Question 2 How to establish the target specification of this new product ? (10 points)

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2. .....
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4. .....
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Table 1 shows the result of target specification of new automatic can crusher by a design team.

	probability of injury < 0.1 %	weight < 30 ib	sale price < $ 50.0	number of parts < 100	dimensions (inch)	crushing force > 30 lb	people able to use > 5 yrs	Manufacturing cost < $200	steps to operate (1)	maintenance cost < $10 annually	efficiency rating > 95 percentile	internal parts enclosed (100%)	storage of crushed cans (60 cans)	loader capacity > 30 cans	crush >= cans/min	crush >= 1.2 x 10 m/min	crush >= 0.57 kg/min	niose output < 30 db	Start < 10 sec	runs > 2 hrs at tims	stop < 5 sec	vibration magnitude < 5 mm	vibration < 4/sec	withstand <= 250 N	maintenance < 4 hrs/yr	# colors (6)	lifespan > 4000 hrs
easy access to clear jammed cans	3			6			3	3		3	6				6	6	6								3		3
crushing mechanism humanly inaccessible	9	1	3	3	3		9	3				9									1						
machine rendered inoperable when opened	9		1	6			9	9				1									9						
easily accessible kill swich	9		3	7			9	3	3												9						
ability to stop in mid operation	9		1	3			9	6	1						1	1	1				9						
no flying debris	9						9			1		6															
runs on 110v standard U.S house outlet			6	3		3	9	9	6		9				6	6	6	3		1							
easy to start			3				9	6	6										9								
long running capability			6	1			7			9	9			1	2	2	2	3		9		2	1		9		9
high efficiency engine			6	1		9		9		9	9				6	6	6	2				2	2		9		9
high material strength		9	6			3		9		6					1	1	1								6		9
small force required to depress the switches	9						9	3																			
safety stickers	9						9	2	2																		
machine reset button after kill switch activated	9			6			9	3	2										6								
operation steps sticker				6			9	3	9																		
parts easy to acquire			6				3	9		9															9		
internal parts safe from liquid damage	2		4	4				3		9	6	9													6		9
crush many cans/min			9	6	1	9	3	9			6		6	9	9	9	9	9	1	1		3	3				3
no sharp corners	9						9	6																			
stops easily and immediately	9			3			9	6	1	6											9						
low vibration		6		3	3	6		3		1					9	9	9	9				9	9				3
low peripheral force		6		3	3	6		3		1					9	9	9	9				9	9				3
shock absorption		6		3	3	6		3		1					9	9	9	9				9	9				3
utilize gravity in design		9	3	6	9			9			1							3				1	1				3
no exhuast	9		1	1			9											1									
low maintenance cost			6	6			8	3		9	6	1								6		6	6	7	9		9
low noise output	9		4	3			6	6				9			1	1	1	9		1		3	3				
start up immediately			3	5				3			6				1	1	1		9								
low loading height	6		1		9		9																				
easily accessible interior	3		3				6	3		3		3			3	3	3				1				9		6
no service required			9	2			6			9	9									3				6	9		9
sealed bearings								3				6													9		6
limit number of tight tolerances															3	3	3										
low operation cost			9	3			6	3		6	6									6					9		3
easy access to jammed cans	6		3				3	3		6	3	3			3	3	3				6				6		4
little heat produced	1			1		2					9									3		1	1		1		4
extra wiring insulation	6	1		1				1																			2
enough force to crush glass,plastic						9	6	9							9	9	9							9			
inconspicuous			6		6		6	3					6	6								6	6			9	

From table 1, Numerical values between 1 and 9 are assigned between each wish and engineering characteristic to rank the correlation between them;

- 1 is very low correlation
- 9 is a very high correlation
- Blank spaces correlation show to no correlation

Question 3 From table 1, Please clarify and divide the problem of automatic can crusher to be sub-problems. (10 points)

3.1 Decompose by key of sequence of users action. (4 points)

- .....
- .....

3.2 Decompose by key of customer needs. (4 points)

- .....
- .....

3.3 Chooses the sub-problems that are most critical to success of the product. (2 points)

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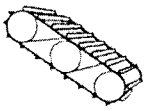
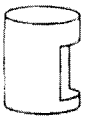
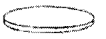
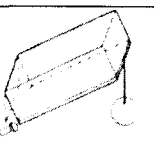
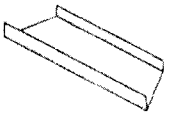
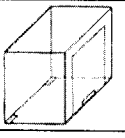
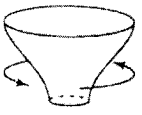
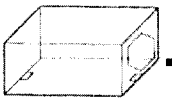
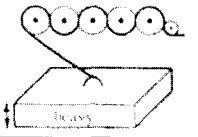
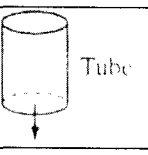
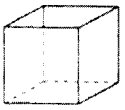
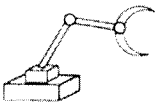
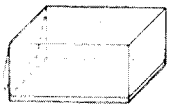
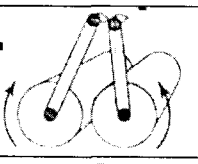
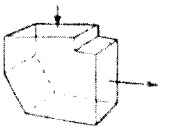
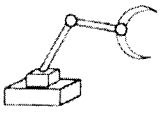
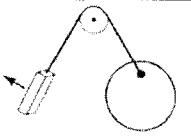
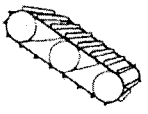
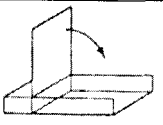
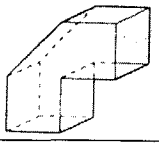
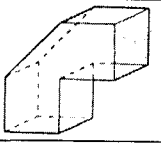
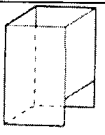
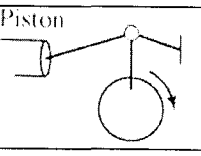
.....

Then, the design team lists all functions that must be accomplished and generate a matrix that shows the functions in the right column. They point out different ways to achieve these functions.

Several design can be generated from the morphological chart. Several concepts are sketched in Table 2

Table 2 shows Morphological chart of automatic can crusher.

Option	Loader	Aligner	Holder	Actuator	Crusher	Ejector
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

In this stage, the design begins to limit the possible designs based on specifications, manufacturability, cost, and other factors. The concepts are shown in figure 1 – 4. A decision matrix is constructed to evaluate the designs based on the wishes obtained from the specification table. Specifications are weighted by importance, with 1 being the lowest and 10 being the highest. The concept II are evaluated and chosen by the design team to be the best possible design. This design is considered the datum by which all the other designs are compared. All of the other designs are evaluated against the datum and receive a + if they exceed the datum in the wish, a – if they are below the datum in the wish, and 0 if they are equal to the datum in the wish

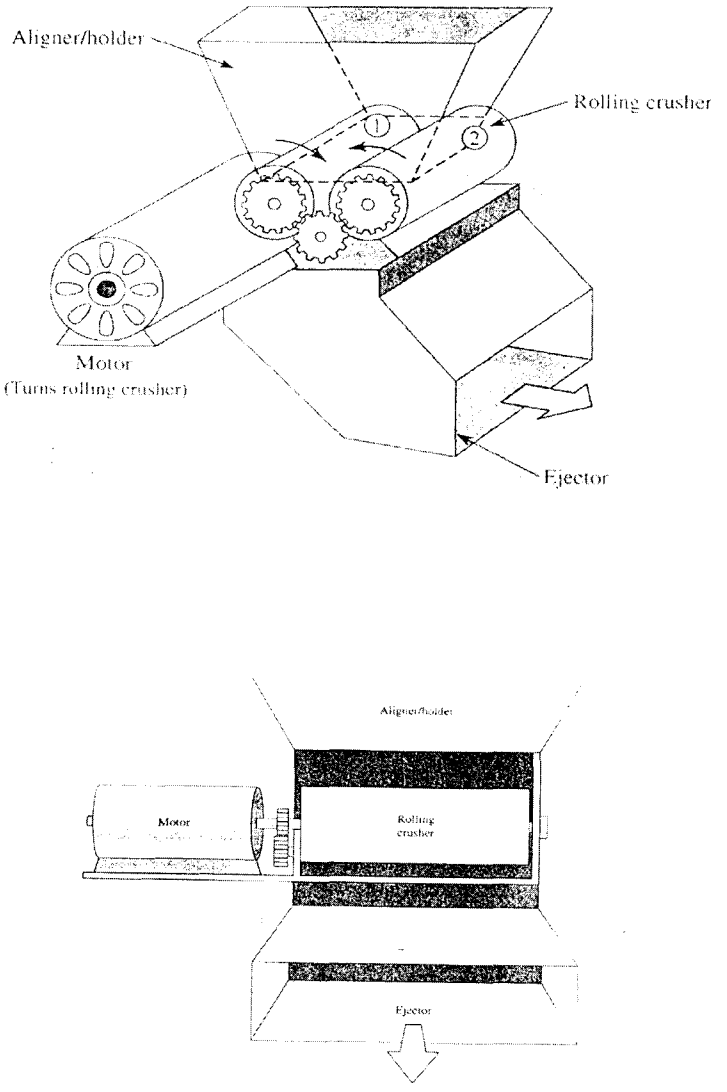


Figure 1 Concept I of automatic can crusher

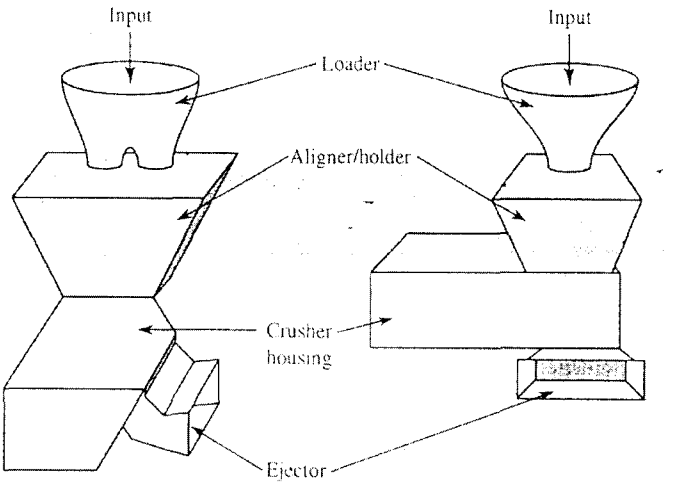


Figure 2 Concept II of automatic can crusher

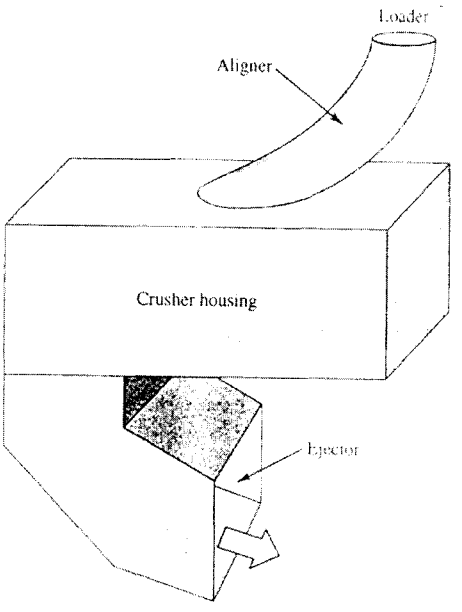
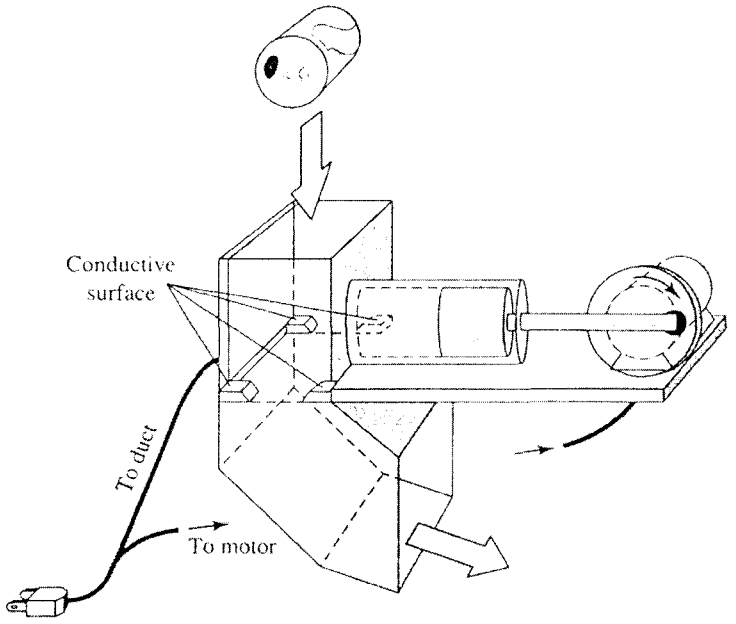


Figure 3 Concept III of automatic can crusher



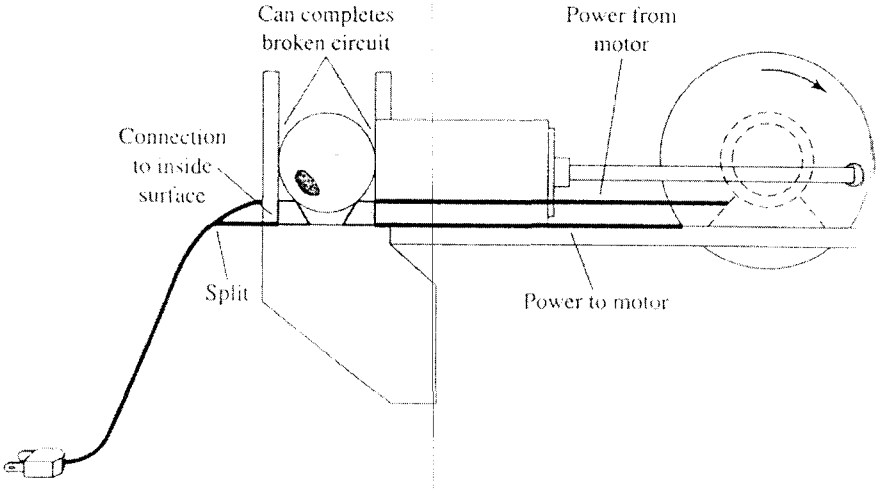


Figure 4 Concept II of automatic can crusher

Table 3 shows the evaluation of designs: conept II is datum

		concept			
criterion	wt	1	2	3	4
inoperable when opened	10	0		0	0
run on standard 110 - v outlet	7	0		0	0
<$ 50 retail	9	0		0	0
enough force to crush glass and plastic	3	0	D	0	0
large storage of crushed cans	5	0	A	0	0
easily accessible kill switch	3	0	T	0	0
no sharp corners	10	0	U	0	0
easy to start	8	0	M	0	0
stop easily and immediately	9	0		0	0
can stop in mid operation	8	0		0	0
drains residual fluid from machine	10	0		0	0
low vibration	8	0		0	0
low peripheral force	8	0		0	0
shock absorption	8	0		0	0
high-efficiency engine	8	0		0	0
high material strength	9	0		0	0
small force to depress switches	9	0		0	0
safety stickers	9	0		0	0
reset button	9	0		0	0
no flying debris	9	0		0	0
operating steps stickers	9	0		0	0
low loading height	7	0		0	0
easily accessible interior	7	0		0	0
crushing mechanism inaccessible	10	-		-	0
crush many cans a minute	9	+		0	0
utilize gravity in design	4	0		0	0
low noise output	5	0		0	0
start up immediately	5	0		0	0
easy access to clear jams	6	-		0	0
large capacity loader	5	+		0	0
long running capability	7	0		0	0
parts easy to acquire	8	-		0	0
internal parts safe from liquid damage	9	0		0	0
low operating cost	5	0		0	0
easy cleaning	6	-		0	0
easy to disassemble	6	0		0	0
crushes along major axis	2	0		0	+
no exhaust	2	0		0	0
Total +		2		0	1
Total -		4		1	0
Overall total		-2		-1	1
Weighted total		-16		-10	2

Question 4 The concept IV of automatic can crusher is the highest scoring. Do you think that some concepts could be revised or combined? List and draw the new concept of these revised or combined automatic can crusher, if you agree. (20 points)

Question 5 Design for manufacturing and design for assembly. (15 points)

5.1 What is the concept of design for manufacturing? (5 points)

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5.2 Write the definition of design for assembly, and describe its importance in design for manufacturing. (5 points)

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5.3 What specifically is the Boothroyd-Dewhurst method approach to design for assembly? (5 points)

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Question 6 About the concept of jig, fixture and clamp design. (15 points)

6.1 Define the differences between jig and fixture? (5 points)

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6.2 What is the purpose of the 3-2-1 principle when used with a fixture? (5 points)

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6.3 If a designer is given a print of a workpiece. What must he do before he can begin designing a fixture? What information and data must be collected? (5 points)

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