Name _____ Student ID _____

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

Final Examination: Semester 1   Academic Year: 2005
Date: 3 October 2005   Time: 9.00 – 12.00
Subject: 225-502 Experimental Designs   Room: R 300

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียนหนึ่งภาคการศึกษา
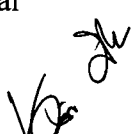

Instructions: Read carefully
1. All materials are allowed.
2. There are 5 problems, do all of them. Also show your work clearly and legibly.
3. Answer the questions in this test paper, only.
4. You must write your name and your student ID in every page of the test.
5. Total score is 100 points.

Distribution of Score

Problem	Points	(a)	(b)
1	15	-	-
2	20	-	-
3	20	-	-
4	30	-	-
5	15	7	8

Tests are prepared by
Nikorn Sirivongpaisal

Problem 1: (15 points) An industrial engineer is conducting an experiment on eye focus time. He is interested in the effect of the distance of the object from the eye on the focus time. Four different distances are of interest. He has five subjects available for the experiment. There may be differences among subjects. The data obtained from this experiment are shown in the table below. Analyze the data (use $\alpha = 0.05$) and draw appropriate conclusions.

Distance (ft)	Subject				
	1	**2**	**3**	**4**	**5**
4	10	6	6	6	6
6	7	6	6	1	6
8	5	3	3	2	5
10	6	4	4	2	3

Problem 2: (20 points) An experiment was conducted to determine if either firing temperature or furnace position affects the baked density of a carbon anode. The data are shown below.

Position	Temperature ($^\circ C$)		
	800	**825**	**850**
1	570	1063	565
	565	1080	510
	583	1043	590
2	528	988	526
	547	1026	538
	521	1004	532

Suppose we assume that no interaction exists. Write down the statistical model. Conduct the analysis of variance and test hypotheses on the main effects. What conclusions can be drawn? Use $\alpha = 0.05$.

Problem 3: (20 points) An industrial engineer is interested in the effects of two different types of 32-ounce bottles on the time to deliver 12-bottle cases of the product. The two bottle types are glass and plastic. Two workers are used to perform a task consisting of moving 40 cases of the product 50 feet on a standard type of hand truck and stacking the cases in a display. Experiment is performed, and the times observed are listed in the following table. Analyze the data and draw appropriate conclusions. Use $\alpha = 0.05$.

Bottle Type	Worker			
	1		**2**	
Glass	5.12	4.89	6.65	6.24
	4.98	5.00	5.49	5.55
Plastic	4.95	4.43	5.28	4.91
	4.27	4.25	4.75	4.71

Problem 4: (30 points) In a process development study on yield, four factors were studied, each at two levels: time *(A)* 2.5 hours and 3.0 hours, concentration *(B)* 14% and 18%, pressure *(C)* 60 psi and 80 psi, and temperature *(D)* 225 $^\circ C$ and 250 $^\circ C$. The resulting data are shown in the following table. Analyze the data and draw appropriate conclusions. Use $\alpha = 0.05$. Also write down a regression model relating yield to the important process variables.

Run Number	A	B	C	D	Yield
1	-	-	-	-	12
2	+	-	-	-	18
3	-	+	-	-	13
4	+	+	-	-	16
5	-	-	+	-	17
6	+	-	+	-	15
7	-	+	+	-	20
8	+	+	+	-	15
9	-	-	-	+	10
10	+	-	-	+	25
11	-	+	-	+	13
12	+	+	-	+	24
13	-	-	+	+	19
14	+	-	+	+	21
15	-	+	+	+	17
16	+	+	+	+	23

Problem 5: (15 points)

(a) Construct a 2^5 design in four blocks with $ACDE$ and BCD confounded.

(b) Construct one-half fractional factorial design for 2^5 design, which uses $E=AB$ as a design generator. Also identify the alias structure of this design and what is the design resolution?.