KENYA METHODIST UNIVERSITY

END OF FIRST TRIMESTER 2008 EXAMINATIONS

FACULTY	**:**	**SCIENCE AND SOCIAL STUDIES**
DEPARTMENT	**:**	**COMPUTER AND INFORMATION SCIENCE**
COURSE CODE	**:**	**MATH 433**
COURSE TITLE	**:**	**DESIGN AND ANALYSIS OF EXPERIMENTS**
TIME	**:**	**2 HOURS**

Instructions:

- *Answer question **ONE** (compulsory) and any other **TWO** questions.*

Question 1

a) Explain the following terms as used in experimental design, highlighting atleast two functions of each.
(i) Replication.
(ii) Randomization.
(iii) Local control (6 mks)

b) The table below gives yield in kg of five lentil varieties under rainfall conditions in Western Kenya. The varieties were arranged in a CRD.

Varieties		Yield		
1	740	430	760	640
2	545	440		
3	325	290		
4	740	630	870	
5	605	505	430	540

At level of significance $\alpha = 5\%$, test whether or not the five varieties of lentil differ in their yield. (3 mks)

c) Consider a 3-way classification model with no interactions.
$y_{ijk} = \mu + t_i + \beta_i + r_k + \varepsilon_{ijk}$
where ε_{ijk} *is* $N(0, \sigma^2)$, μ, t_i, β_j, *and* r_k
are unknown constants, $i = 1,2,...p,\ \ j = 1,2,,q$ *and* $k = 1,2,...,r.$
(i) Estimate $\mu, t_{i,} \beta_j$ *and* r_k.

(ii) Write down the ANOVA table. (7 mks)

d) Write down orthogonal Latin Squares 4 x 4 and use them to construct a Balanced Incomplete Block (BIB) design. Give the parameters of this BIB design. (9 mks)

Question 2

a) The following is a field plan of a 2^3 factorial experiment.

	Replication 1			
Block 1	(0,1,0),	(0,1,1),	(1,0,0),	(1,0,1)
Block 2	(0,0,0),	(0,0,1),	(1,1,0),	(1,1,1)

	Replication 2			
Block 1	(0,1,0),	(1,1,0),	(0,0,1),	(1,0,1)
Block 2	(0,0,0),	(1,0,0),	(0,1,1),	(1,1,1)

Find out the treatment effects which are confounded in each of the replications. (6 mks)

b) The voltage within an electronic system was to be investigated for four different conditions A, B, C, D but unfortunately the voltage measurements were affected by the line voltage within the laboratory. Since the line voltage assumed the same pattern within each day due to the usage patterns of various industrial firms in the area and since the general level of line voltage varied from day to day, a Latin square design was used. The layout plan is given below.

		Days			
		1	2	3	4
Time period	1	A(116)	B(108)	C(126)	D(112)
within a day	2	C(111)	D(124)	A(122)	B(121)
	3	B(120)	C(115)	D(126)	A(109)
	4	D(118)	A(125)	B(116)	C(127)

Analyse the data and test whether

(i) Treatment.

(ii) Time period within a day are significantly different at 5% level of significance. (14 mks)

Question 3

a) Define a Balanced Incomplete Block design. (3 mks)

b) State the conditions for BIB design to exist. (3 mks)

c) A randomized block experiment was carried out to compare three bonding agents: Nickel, Iron and copper. A pair of components from each ingots are bonded together using each of the three agents and the pressure required to separate the bonded components is measured.

	Bonding Agent		
Ingot	Nickel	Iron	Copper
1	67.0	71.9	72.2
2	67.5	68.8	66.4
3	76.0	82.6	74.5
4	72.7	78.1	67.3
5	73.1	74.2	73.2

Analyse the data and test whether there is a difference in pressure required to separate the components among the three bonding agents at level $\alpha = 0.01$ (14 mks)

Question 4

a) Define.
   (i) Graeco Latin square.
   (ii) Factorial experiment.
   (iii) Completely randomized design. (6 mks)

b) An experiment was carried out to study the effect of Sulphate Potash and Super Sulphate on the yield of potatoes. All combinations of 2 levels of Sulphate Potash 0% (K_0) and 5% (K_1) per acre and 2 level of Super Sulphate 0% (P_0) and 5% (P_1) per acre were studied in a randomized block design with 4 replications for each. The following yields (kg per acre) were obtained.

Block	Plots			
I	(1)	K	P	KP
	23	25	22	38
II	P	(1)	K	KP
	40	26	36	38
III	(1)	K	KP	P
	29	20	30	20
IV	KP	K	P	(1)
	34	31	24	28

Calculate the various sums of squares and give the ANOVA TABLE. State the conclusions that can be made from the ANOVA table at $\alpha = 10\%$. (14 mks)