KISII UNIVERSITY
UNIVERSITY EXAMINATIONS
FIRST YEAR EXAMINATION FOR THE AWARD OF
THE DEGREE OF MASTER OF SCIENCE APPLIED STATISTICS
FIRST SEMESTER 2022/2023
(JUNE-SEPTEMBER, 2022)

MATH 870: DESIGN AND ANALYSIS OF EXPERIMENT I

STREAM: Y1S1   **TIME: 3 HOURS**

DAY: THURSDAY, 8.00 AM – 11.00 AM   **DATE: 22/09/2022**

INSTRUCTIONS:

1. *Do not write anything on this question paper.*
2. *Answer Question ONE (Compulsory) and Any Other TWO Questions*

QUESTION ONE (30 MARKS)

a) Explain the following terms as used in experimental design
i)   Local control   (2marks)
ii)   Randomization   (2marks)
iii)   Replication   (2marks)
b) State two advantages and two disadvantages of Randomized Block Design(4marks)
c) In testing the hardness of metal coupons four tips are available, each tip is tested at once of each coupon resulting into a Randomized Block Design. However due to unavoidable circumstances coupon three was broken when tip two was being tested. The data point was obtained as shown below;

Type of tip	Coupon blocks			
	1	2	3	4
1	9.3	9.4	9.6	10.0
2	9.4	9.3	X	9.9
3	9.2	9.4	9.5	9.7
4	9.7	9.6	9.6	10.2

Estimate the missing value X   (5marks)

d) Suppose we have a set of four treatments. Draw a layout of the Latin Square Design
                                                                     (2marks)

e) State four properties of Balanced Incomplete Block design   (4marks)

f) Given the Complete randomized block Design model as $Y_{ij} = \mu + t_i + \varepsilon_{ij}$,
   determine the estimates of μ and t_i

i) $\hat{\mu}$ (3marks)

ii) $\hat{t_i}$ (3marks)

g) Describe the procedure in testing the hypothesis that
$$H_0;\ b_1 = b_2 = - - -b_b \text{vs}$$

$$H_1: Anything\ different$$

for Randomized Block Design   (3marks)

QUESTION TWO (20 MARKS)

a) Explain what is meant by Complete Randomized Design   (2marks)

b) Test whether the following types of sorghum are significantly different at
   α=0.05 level of significance.

A	B	C	D
25	19	22	23
24	21	23	24
28	25	26	26

                                                                     (13marks)

QUESTION THREE (20 MARKS)

a) Draw a layout of Randomized block design with four different treatments (2marks)

b) The plant manager decided to run an experiment to determine whether the material
   received at different times has the same tensile strength. Five randomly chosen time
   periods are to be considered and 5 randomly chosen men work on the material

		MEN				
		1	2	3	4	5
Time periods	1	7.5	11.8	17.6	4.8	17.9
	2	21.4	12.9	12.4	15.0	20.6
	3	16.0	9.7	7.4	18.4	16.6
	4	16.0	18.3	23.6	27.4	25.2
	5	23.3	30.5	25.8	24.5	26.6

Test at 5% level of homogeneity of time periods and homogeneity of men (13marks)

QUESTION FOUR (20 MARKS)

a) Under which conditions is Balanced Incomplete block Design preferred in the analysis of experiment (2marks)

b) An experiment was conducted to compare the effect of seven chemical substances on the skin of male rats. The area of experimentation on the animal skin was confined to a region which was to be relatively homogeneous. But this restricted the experimenter to three experimental units per animal. To eliminate the rat to rat variability for comparison of treatment, the experiment was blocked on rats using Balanced Incomplete Block Design.

1	2	3	4	5	6	7
$T_1(10.3)$	$T_4(12.9)$	$T_3(11.7)$	$T_5(9.1)$	$T_2(8.8)$	$T_5(9.2)$	$T_1(11.3)$
$T_2(6.9)$	$T_6(14.1)$	$T_2(12.1)$	$T_7(7.7)$	$T_7(8.6)$	$T_6(15.2)$	$T_3(9.7)$
$T_3(14.2)$	$T_3(9.9)$	$T_5(8.6)$	$T_4(14.3)$	$T_6(16.3)$	$T_1(13.1)$	$T_7(6.2)$

Do the data present evidence in the effect of chemical substance on the skin at 5% level of confidence (13marks)

QUESTION FIVE (20MARKS)

a) State three conditions under which Latin Square Design performs better than Randomized block design. (3marks)

b) Carry out the test for the 4x4 Latin Square Design at 5% level of significance.

$T_1(10)$	$T_2(8)$	$T_3(5)$	$T_4(4)$
$T_2(11)$	$T_4(13)$	$T_1(16)$	$T_3(12)$
$T_3(10)$	$T_1(14)$	$T_4(9)$	$T_2(10)$
$T_4(8)$	$T_3(6)$	$T_2(11)$	$T_1(13)$

(12marks)