# KISII UNIVERSITY

## UNIVERSITY EXAMINATIONS

### FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF MASTERS OF MATHEMATICAL STATISTICS SECOND SEMESTER 2022/2023 [JANUARY – APRIL, 2023]

### MATH 871: DESIGN AND ANALYSIS OF EXPERIMENT II

**STREAM:  Y1 S2**                                            **TIME: 3 HOURS**

**DAY: THURSDAY, 9:00-12:00 P.M**               **DATE:  16/03/2023**

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## INSTRUCTIONS

**1. Do not write anything on this question paper.**
**2. Answer question ONE (Compulsory) and any other TWO questions.**

## QUESTION ONE (30 MARKS)

1a) Define Galois field                                                                                      (2mks)

b) State 4properties of plane projective Geometry                                      (4mks)

2. Prove the following conditions for the existence of Balanced Incomplete Block Design

a) $bv = rv$                                                                                                        (5mks)

b) $\lambda(v - 1) = r(k - 1)$                                                                              (5mks)

c) $\det(N'N) = (r - \lambda)^{v-1}kr$                                                                 (5mks)

c) Explain the meaning of symmetrical factorial design                              (2mks)

d) Obtain treatment effects of a $2^2$ factorial design                                  (4mks)

e) Describe the orthogonal Latin Square design                                          (3mks)

**QUESTION TWO 20 MARKS**

Consider the data below containing four blocks of farms with application of different fertilizers.

| BLOCK1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | I | NP | KP | NK | K | N | NPK |
| 300 | 80 | 320 | 420 | 330 | 370 | 130 | 470 |

| BLOCK2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | I | NP | KP | NK | K | N | NPK |
| 290 | 100 | 370 | 390 | 290 | 270 | 110 | 450 |

| BLOCK3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | I | NP | KP | NK | K | N | NPK |
| 320 | 110 | 340 | 400 | 300 | 270 | 90 | 450 |

| BLOCK4 | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | I | NP | KP | NK | K | N | NPK |
| 320 | 130 | 360 | 430 | 270 | 300 | 100 | 430 |

a) Test the homogeneity of the fertilizers at $\alpha=0$. (10mks)
b) Test the significance of each treatment of fertilizers (10mks)

**QUESTION THREE 20MARKS**

a) Explain what is meant by Balanced Incomplete block Design 2mks
b) An experiment was conducted to compare the effect of V=7 chemical substances on the skin of male rats. The area of experimentation on the animal skin was confined to a region which was confined to a region that was known to be relatively homogeneous, but this restricted the experimenter to three experimental units per animal. Hence to eliminate the rat to rat variability the comparison of treatments, the experimenter was blocked on rats using the BIBD shown below.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| T1 10.2 | T4 12.9 | T3 11.7 | T5 11 | T2 8.8 | T5 9.2 | T1 11.3 |
| T2 6.9 | T6 14.1 | T2 12.1 | T7 7.7 | T7 8.6 | T6 15.2 | T3 9.3 |
| T4 14.2 | T3 9.9 | T5 8.6 | T4 14.3 | T6 16.3 | T1 13.1 | T7 6.2 |

The seven blocks correspond to seven rats.

Do the data present evidence to indicate a real difference in the effect of chemical substances on the skin at 5% level of significance? (18mks)


**QUESTION FOUR 20 MARKS**

To test the moisture content of turnip greens, the data below shows a table of moisture content in percentage leaf size (A=smallest, E= largest)

| Plant | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 6.8 (v) | 7.1 (iv) | 8.3 (i) | 8.8 (iii) | 9.6 (ii) |
| 2 | 5.4 (ii) | 4.8 (v) | 5.4 (iv) | 7.5 (i) | 6.5 (iii) |
| 3 | 7.3 (iii) | 8.5 (ii) | 8.5 (v) | 9.2 (iv) | 9.7 (i) |
| 4 | 4.5 (i) | 5.0 (iii) | 7.3 (ii) | 7.8 (v) | 7.1 (iv) |
| 5 | 4.8 (iv) | 6.2 (i) | 8.8 (iii) | 5.8 (ii) | 8.1 (v) |

a) Compute ANOVA and test for homogeneity (10mks)
b) Test the effect of size of each leaf size on moisture content (10mks)