



**MASENO UNIVERSITY**

**UNIVERSITY EXAMINATIONS 2016/2017**

**FOURTH YEAR FIRST SEMESTER EXAMINATIONS FOR  
THE DEGREE OF BACHELOR OF SCIENCE IN APPLIED  
STATISTICS WITH INFORMATION TECHNOLOGY**

**MAIN CAMPUS**

**IAS 405: ANALYSIS OF EXPERIMENTAL DESIGNS II**

Date: 1<sup>st</sup> December, 2016

Time: 12.00 - 3.00 pm

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**INSTRUCTIONS:**

Answer question ONE and any other TWO questions.

Observe further instructions on the answer booklet.



# QUESTION ONE

[30 Marks]

- (a) What is meant by a Randomised Block Design? (2 Marks)
- (b) What are the conditions that must be met in order for a design to be called a Partially Balanced Incomplete Block Design? (4 Marks)
- (c) Prove Fisher's inequality that states that in a BIB design,  $b \geq v$ . (8 Marks)
- (d) Define a Youden Square design and give the conditions for its existence. (6 Marks)
- (e) Evaluate the primary and secondary parameters of the following PBIB design;

$$B_1 = (1, 2, 3, 4)$$

$$B_2 = (2, 3, 6, 7)$$

$$B_3 = (5, 6, 7, 8)$$

$$B_4 = (1, 2, 6, 5)$$

$$B_5 = (1, 4, 8, 5)$$

$$B_6 = (3, 4, 7, 8)$$

(10 Marks)

## QUESTION TWO

[20 Marks]

- (a) Describe a Balanced Incomplete Block Design. (3 Marks)
- (b) For a BIB design to exist, two conditions must be satisfied. What are these conditions? (2 Marks)
- (c) From equations of 2-flat in  $PG(2,3)$  and  $EG(2,3)$ , construct BIB designs. (15 Marks)

## QUESTION THREE

[20 Marks]

An engineer is studying the mileage performance characteristics of five types of gasoline additives. In the road test, she wishes to use cars as blocks. She decides to use an incomplete block design run with the five blocks as shown here. Analyse the data and draw appropriate conclusions.

Additive	car 1	car 2	car 3	car 4	car 5
1	-	17	14	13	12
2	14	14	-	13	10
3	12	-	13	12	9
4	13	11	11	12	-
5	11	12	10	-	8

## QUESTION FOUR

[20 Marks]

(a) Define a treatment contrast. When are two such contrasts said to be orthogonal?

(5 Marks)

(b) An experiment was planned to study the effect of a solvent of Potash (P) and Super-Phosphate (K) on the yields of potatoes. All combinations of 2 levels of K and two levels of P were studied in a Randomised Block Design with 4 replications, given the following yields;

Block I:  $(1)=23; (k)=25; (p)=22; (pk)=38$

Block II:  $(p)=40; (1)=26; (k)=36; (pk)=38$

Block III:  $(1)=29; (k)=20; (pk)=30; (p)=20$

Block IV:  $(pk)=34; (k)=31; (p)=24; (1)=28$

Analyse the data.

(15 Marks)

## QUESTION FIVE

[20 Marks]

(a) Construct a  $2^4$  design in which  $A_1A_2A_3$  and  $A_2A_3A_4$  are confounded.

(5 Marks)

(b) For a factorial experiment with three factors, each at two levels, obtain the estimates of the main effects, two-factor interactions and three-factor interactions.

(10 Marks)

(c) If the eight treatments in (b) above are denoted by  $(X_1, X_2, X_3)$  where  $X_i = 0, 1$   $i = 1, 2, 3$  are arranged in two replications having two blocks with the following field plan;

### Replication 1

Block One:	(0,1,0)	(0,1,1)	(1,0,0)	(1,0,1)
Block Two:	(0,0,0)	(0,0,1)	(1,1,0)	(1,1,1)

### Replication 2

Block One:	(0,1,0)	(1,1,0)	(0,0,1)	(1,0,1)
Block Two:	(0,0,0)	(1,0,0)	(0,1,1)	(1,1,1)

Find out the confounded treatment effects.

(5 Marks)