MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FOUR YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE EDUCATION (SCIENCE)

SMA 464: DESIGN AND ANALYSIS OF EXPERIMENTS I

DATE: 6/5/2019 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS: Answer question one (1) and any other two (2) questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Define a symmetric BIBD. (2 marks)

b) Explain each of the following parts of design and analysis of experiments:

- i) Designing of experiments (2 marks)
- ii) Construction of experiments (2 marks)
- iii) Analysis of experiments (2 marks)

c) Explain the following three main principles of design and analysis of experiments.

- i) Randomisation (2 marks)
- ii) Replication (2 marks)
- iii) Local control (2 marks)

d) In a randomized complete block design (RCBD)

- i) Blocks are said to be complete. Explain. (1 mark)
- ii) Blocks are randomized. Explain. (1 mark)
- iii) Randomization is restricted. Explain. (1 mark)

e) State one advantage and one disadvantage of the completely randomized design (CRD).

(2 marks)

f) Adhesive force on gunned material was determined under fixed humidity and fixed temperature conditions. Four readings were made under each set of conditions. The experiment was completely randomized and the results set out in an ANOVA table as follows:

SOURCE OF VARIATION	df	SS
Humidity (H)		60
Temperature (T)		45
H x T (interaction) Error		35
Total		165

i) Determine the degrees of freedom. (2 marks)

ii) Analyze the experiment at 5% level of significance and make statistical conclusions. (5 marks)

g) Show that in a Balanced Incomplete Block Design (BIBD),

$$\lambda(v-1) = r(k-1)$$ (4 marks)

QUESTION TWO (20 MARKS)

a) Distinguish between a completely randomized design (CRD) and a randomized complete block design (RCBD). (2 marks)

b) Data from an experiment were as given below.

T1	**T2**	**T3**	**T4**	**T5**	**T6**
8	12	19	10	6	7
9	13	20	12	8	9
12	10	16	13	11	13
	11	18	15	10	16
		19			13

i) Explain one advantage that the Latin Square Design has over the design used above. (3 marks)

ii) Calculate the necessary sums of squares. (5 marks)

iii) Construct the ANOVA table. (5 marks)

iv) Draw conclusions at 5% level of significance. (2 marks)

c) Using an illustration, define the term *'treatment contrast'* as it is used in factorial designs. (3 marks)

QUESTION THREE (20 MARKS)

An experiment was conducted and the following data were recorded.

$t_3(20)$	$t_1(30)$	$t_2(24)$
$t_1(25)$	$t_2(26)$	$t_3(18)$
$t_2(22)$	$t_3(20)$	$t_1(24)$

i) Describe the design used in this experiment. (2 marks)

ii) Formulate a hypothesis you may wish to test. (3 marks)

iii) Calculate the necessary sums of squares. (8 marks)

iv) Analyze the data and draw statistical conclusions at 1% level of significance. (7 marks)

QUESTION FOUR (20 MARKS)

The following data were obtained from an experiment.

	Age 1	**Age 2**	**Age 3**	**Age 4**
Breed 1	$t_{11}t_{21}(10)$	$t_{12}t_{22}(4)$	$t_{13}t_{23}(8)$	$t_{14}t_{24}(18)$
Breed 2	$t_{12}t_{23}(21)$	$t_{11}t_{24}(11)$	$t_{14}t_{21}(7)$	$t_{13}t_{22}(31)$
Breed 3	$t_{13}t_{24}(26)$	$t_{14}t_{23}(13)$	$t_{11}t_{22}(27)$	$t_{12}t_{21}(24)$
Breed 4	$t_{14}t_{22}(13)$	$t_{13}t_{21}(22)$	$t_{12}t_{24}(38)$	$t_{11}t_{23}(17)$

t_1 = feed, t_2 = deworming drug

a) Calculate the necessary sums of squares. (12 marks)

a) State one advantage of the Graeco-Latin square design over the Latin square design and the RCBD. (1 mark)

b) Suppose, in an experiment, there are 3 factors F_1, F_2 and F_3 with 2 levels each.

i) Calculate the number of treatments . (2 marks)

ii) Construct all the treatments. (5 marks)

QUESTION FIVE (20 MARKS)

a) In an experiment the following data was obtained.

B1	B2	B3	B4	B5	B6
$t_1(5)$	$t_1(10)$	$t_1(15)$	$t_2(26)$	$t_2(9)$	$t_3(16)$
$t_2(5)$	$t_3(20)$	$t_4(35)$	$t_3(44)$	$t_4(11)$	$t_4(24)$

i) Find the adjusted treatment totals. (4 marks)

ii) Find the adjusted treatment sums of squares, s_{tr}^2(adj). (3 marks)

iii) Find the unadjusted block sums of squares, s_b^2(unadj). (3 marks)

b) i) Show that 3 is a primitive root in mod(7) = GF(7), whereas 4 is not a primitive root. (2 marks)

ii) Let s = p = 5. Construct the two orthogonal Latin squares l_4 and l_5. (4 marks)

c) State any four (4) axioms that a finite plane projective geometry must satisfy. (4 marks)