MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

THIRD YEAR **FIRST** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN APPLIED STATISTICS WITH PROGRAMMING

AMS308 – DESIGN AND ANALYSIS OF EXPERIMENT I

DURATION: 2 HOURS

DATE: 14TH DECEMBER 2017

TIME: 2.00PM – 4.00PM

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A (Compulsory)

QUESTION ONE (30 Marks)

a) Differentiate between assignable and random (chance) causes of variation. (2 Marks)

b) State the statistical model for each of the following experimental design and state what each of the components in the model stands for;

i. Randomized block design with interaction

ii. Latin square design (6 Marks)

c) A computer ANOVA output is shown below. Fill in the blanks and make a conclusion at $\propto = 5\%$.

Sources of variation	Degrees of freedom	Sum of square	Mean sum of square	Fratio
Treatment	-	-	246.93	-
Error	18	186.53	-	
Total	23	1174.24		

(4 Marks)

d) State the three (3) basic principles of an experimental design and briefly explain them. (6 Marks)

e) i) Define a Latin square (SXS)

ii) When are two Latin squares each (SXS) said to be orthogonal? (4 Marks)

f) Consider a 2^2 factorial design

i. Write out the main effects and 2-factor interactions. (3 Marks)

ii. What is meant by confounding in a factorial experiment? (1 Mark)

g) What are the necessary and sufficient conditions for a Balanced Incomplete Block Design (B.I.B.D) to exist? (4 Marks)

SECTION B (Answer any two questions)

QUESTION TWO (20 Marks)

a) State the meaning of the following terms as used in design of experiments;

i. Scientific design of experiment

ii. Experiment

iii. Treatment (3 Marks)

b) i) Consider a randomized block design with the model $y_{ij} = \mu + ti + bj + e_{ij}$ (with usual meaning of symbols), $i = 1,2, \ldots, v, j = 1,2 \ldots b$. Suppose that the observation in j^{th} block belong to i^{th} treatment is missing, obtain an estimator of the missing observation.

(7 Marks)

ii) Consider the randomized block design shown below with the observation belonging to the 2nd treatment in block 3 is missing. Estimate the missing observation.

Treatment

Blocks		1	2	3	4	5
	1	7.3	6.8	7.4	7.1	6.7
	2	7.3	6.7	7.5	7.2	7.0
	3	7.5	-	7.4	7.3	6.8
	4	7.3	7.1	7.5	7.5	6.9

(4 Marks)

iii) Use the above information in (ii) to test whether the treatment or Blocks are statistically significant at $\propto = 5\%$. (6 Marks)

QUESTION THREE (20 Marks)

a) In testing for hardness of four tips metal coupons, each tip is tested once on each coupon, resulting in a randomized complete block design. The data obtained are repeated for convenience in the table below;

	Coupon (Block)			
Types of Tip	1	2	3	4
1	9.3	9.4	9.6	10.0
2	9.4	9.3	9.8	9.9
3	9.2	9.4	9.5	9.7
4	9.7	9.6	10.0	10.2

Test at 5% level of significance whether the metal tips are equal in hardness. (10 Marks)

b) i) Explain what is meant by a randomized block design. (4 Marks)

ii) Give the model used in the analysis of such a design clearly defining each symbol.

(6 Marks)

QUESTION FOUR (20 Marks)

The following table gives the 2^3 factorial designs layed out in four replicated. The purpose of the experiment is to determine the effects of different kinds of fertilizers; Nitrogen (N), Pottash (K) and Phosphate (P) on maize crop yield. Analyze the date and make appropriate conclusions at ∝=0.01 level of significance.

NK(291)	KP(391)	P(312)	NP(373)	I(101	K(265)
N(106)	NPK(450)	KP(407)	P(324)	K(272)	NK(305)
N(89)	NPK(338)	I(106)	P(323)	I(87)	NP(324)
KP(423)	NK(334)	K(279)	N(128)	NPK(471)	NP(361)
NK(272)	N(103)	P(324)	K(302)	I(131	KP(435)

(20 Marks)

QUESTION FIVE (20 Marks)

a) i) Give an analysis of a B.I.B.D design with parameters v, b, r, k, λ (using usual notations).

ii) Explain why in a B.I.B.D

1. $bk = vr$
2. $\lambda(v-1) = r(k-1)$ (8 Marks)

b) Consider a B.I.B.D design with parameters $v = b = 7, r = k = 3$ and $\lambda = 1$. The field plan together with randomization and the observation (yields) is given below;

Block	Treatment and yields		
1	C 5.8	F 5.5	D 7.3
2	B 10.2	G 8.8	F 10.4
3	A 15.0	G 15.7	C 10.1
4	B 5.8	D 6.3	A 8.7
5	E 11.9	C 9.3	B 12.4
6	E 11.2	F 10.5	A 13.7
7	G 13.1	E 12.9	D 7.4

The letters A, B, C, D, E, F and G represent the treatments. Obtain;

i. The Adjusted treatment totals

ii. ANOVA table useful for testing $H_0: T_A = T_B \cdots = T_G$ (that is all treatment effects are the same) VS H_1 : anything different at 5% level of significance. (12 Marks)