(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

3RD YEAR FIRST SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: STA 312

COURSE TITLE: DESIGN AND ANALYSIS OF EXPERIMENT I

DATE: 20/05/2022   **TIME:** 2:00 PM – 4:00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of **4 Printed Pages**. Please Turn Over.

QUESTION ONE (30 MARKS)

a) Discuss three principles of experimentation. (6 mks)
b) Define Null hypothesis (2mks)
c) Define Alternative hypothesis (2mks)
d) Define conjugate in Latin square (3mks)
e) Define orthogonal Latin square (3mks)
f) A newspaper vendor wanted to test whether or not selling on different days had any impact on the mean amount of newspapers sold. The number of lots sold on a day varied from 1 to 4. The data for one week was as shown below

Monday	3,100	3,300		
Tuesday	4,000			
Wednesday	2,600	2,800	2,900	3,000
Thursday	1,800	2,400		
Friday	1,500			

Taking the level of significance as 5% and assuming normality of the random elements, test the null hypothesis of no difference between the days (14 mks)

QUESTION TWO (20 MARKS)

a) Define Graeco-Latin square (2mks)
b) Obtain a Graeco-Latin square from the following orthogonal Latin squares. (6mks)

L_1

A	B	C
B	C	A
C	A	B

L_2

α	β	¥
¥	α	β
β	¥	α

c) Analyse the following randomized block design after estimating the missing value at 5% significance level. (12mks)

Treatments	Blocks			
	1	2	3	4
T_1	9	-	13	16
T_2	16	18	17	23
T_3	10	19	12	16

QUESTION TWO (20MARKS)

Starting with a linear additive model of the form $Y_{ij} = \mu + t_i + e_{ij}$, where μ is the grand mean yield t_i is the ith treatment effect e_{ij} is the random error effect show that $S^2_T = S^2_e + S^2_t$, where S^2_T is total sum of squares S^2_e is sum of squares due to random error S^2_t is sum of squares due to treatment and hence show that the mean sum of squares due to random error $(\frac{S^2_e}{N-k})$ is an unbiased estimator of the error variance, δ^2_e (20mks)

QUESTION THREE (20 MARKS)

a) Define the following terms:
      i)   Treatment   (1mks)
      ii)   Experimental unit   (1mks)

A manufacturer of steel is interested in improving the tensile strength of the product. Product engineers think that tensile strength is a function of the iron concentration in the alloy and that the range of iron concentrations of practical interest is between 5% and 20%. A team of engineers responsible for the study decide to investigate four levels of iron concentration: 5%, 10%, 15%, and 20%. They decide to make up six test specimens at each concentration level, using a pilot plant. All 24 specimens are tested on a laboratory tensile tester in a random order. The data from this experiment are shown in the table below

Hard wood concentration (%)	Observations					
	1	2	3	4	5	6
5	7	8	15	11	9	10
10	12	17	13	18	19	15
15	14	18	19	17	16	18
20	19	25	22	23	18	20

Test at 5% significance level whether or not the hard wood concentration causes a significant difference in the tensile strength.   (18mks)

QUESTION FOUR (20 MARKS)

a) Define type 1 error and type 11 error   (4mks)

b) Analyze the following Latin square design after estimating the missing value at 1% level of significance.   (16 mks)

A	B	C	D
8	9	6	12
B	C	D	A
14	10	7	10
C	D	A	B
13	9	7	12
D	A	B	C
10	11	8	9

QUESTION FIVE (20 MARKS)

In an agricultural station an experiment was performed to determine whether there was any difference in the yield of five varieties of maize. The design adopted was five randomized blocks of five plots each. The yield in kgs per plot obtained in the experiment are given below.

Blocks	Varieties					
	V_1	V_2	V_3	V_4	V_5	Total
1	20	13	24	15	10	
2	29	12	18	15	18	
3	46	33	33	21	39	
4	28	35	26	25	22	
5	34	41	13	48	30	
Total						

Analyse the design and comment on your findings at 5% significance level   (20mks)