CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF

MATH 443: DESIGNS AND ANALYSIS OF EXPERIMENTS

STREAMS: **TIME: 2 HOURS**

DAY/DATE: TUESDAY 10/08/2021   **8.30 A.M - 10.30 A.M.**

INSTRUCTIONS:

- **Answer question one and any other two questions**

Question One (30 marks)

a) (i) Briefly explain the three basic principles used in experimental designs.

(6 marks)

(ii) Which of these principles is not applicable in a completely randomized design? Explain.

(3 marks)

b) The table below shows the lifetime in hours of samples of 3 different types of television tubes manufactured by a company.

Replications				
Sample 1	407	411	409		
Sample 2	404	406	408	405	402
Sample 3	410	408	406	408	

Analyse the data at 5% level of significance to determine whether there is a difference between 3 types. (6 marks)

c) An experimenter wishes to compare 5 treatments, and has resources to take a total of 25 observations, 5 for each treatment. How many residuals (error) degrees of freedom are there if she uses

(i)   A completely randomised design   (2 marks)
(ii)   A randomised block design.   (2 marks)
(iii)   A Latin square design   (2 marks)

(iv)   Give a reason for not using the design with the least number of residual degrees of freedom.   (3 marks)

d) (i) Define a latin square of size (5×5) (3 marks)
    (ii) When are two Latin squares said to be orthogonal?   (3 marks)

Question Two (20 marks)

i)   A study was conducted to determine the effects of sleep deprivation on hand-steadiness. The four levels of sleep deprivation of interest are 12, 18, 24, and 30 hours. 32 subjects were randomly selected and assigned to the four levels of sleep deprivation such that 8 subjects were randomly assigned to each level. The response is the reaction time to the onset of a light cue. The results (in hundredths of a second) are contained in the following table:

Treatment (in hours)

12	18	24	30
20	21	25	26
20	20	23	27
17	21	22	24
19	22	23	27
20	20	21	25
19	20	22	28
21	23	22	26
19	19	23	27

a) Write the model appropriate for this analysis clearly explaining each symbol used.
b) Perform the analysis of variance at 5% level of significance.   (15 marks)

ii)   Give the model for a split plot design explaining clearly the meaning of each symbol used   (5 marks)

Question Four (20 marks)

a) The following table gives fields of wheat per plot in a manurial experiment. The 4 manurial treatments denoted by A, B, C & D

		Column		
Row	1	2	3	4
1	B42	C44	D54	A34
2	D38	A51	B49	C41
3	C51	D51	A54	B60
4	A45	B57	C50	D35

(i)   Prepare an ANOVA table for the data.   (6 marks)

(ii)   Test whether effects of treatment differ significantly from one another at 5% level of significance.   (4 marks)

b) The following data represents a split plot with varieties as whole plot treatments in a randomized complete block design. Row spacing was applied to subplots. The yield in bags per acre for 4 blocks is given in the table below.

Row spacing	Variety	Blocks			
		1	2	3	4
18″	A	33.6	37.1	34.6	35.4
	B	28.0	25.5	29.4	27.3
24″	A	31.1	34.5	32.7	30.7
	B	23.7	26.2	25.8	26.8
30″	A	33.0	29.5	30.7	30.7
	B	23.5	26.8	23.3	21.4
36″	A	28.4	29.9	32.3	28.1
	B	25.0	25.3	26.4	24.6

Perform the   main plot analysis   (10 marks)

Question Five

a) Briefly explain the following terms used in factorial designs.

    (i)   Simple effect   (2 marks)

    (ii)   Main effect.   (2 marks)

    (iii)   Interaction effect between factors.   (2 marks)

b) The following are results of a 2^3 factorial experiment run in a randomised complete block design.

	Blocks		
Treatment	1	2	Total
1	2	3	5
a	6	14	20
b	10	15	25
ab	6	9	15
c	4	6	10
ac	15	25	40
bc	18	22	40
abc	8	12	20
Total	69	106	175

    (i)   Obtain the design matrix x of this design   (3 marks)

    (ii)   Obtain the estimates of factorial effects.   (4 marks)

    (iii)   Give a complete analysis of the experiment and check which factorial effects are significant at 5% level of significance.   (7 marks)

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