ALUPE UNIVERSITY COLLEGE

... *Bastion of Knowledge*....

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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2020 /2021 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE (APPLIED STATISTICS WITH COMPUTING)

COURSE CODE: STA 320

COURSE TITLE: DESIGN AND ANALYSIS OF EXPERIMENTS I

DATE: 14/7/2021 **TIME: 1300-1600HRS**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 5 PRINTED PAGES PLEASE TURN OVER

REGULAR – MAIN EXAM

STA 320: DESIGN AND ANALYSIS OF EXPERIMENTS I

STREAM: ASC   **DURATION: 3 Hours**

INSTRUCTION TO CANDIDATES
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Answer **ALL** questions from section A and any **THREE** from section B.

SECTION A [31 Marks]. Answer ALL questions.

QUESTION ONE (16 MKS)

a) Explain the following terms as they are used in designs and analysis of experiments.
i.	Treatment	(1 mark)
ii.	Experimental unit	(1 Mark)
iii.	Block variable	(1 mark
iv.	KxK latin squares	(1 Mark)

b) Discuss different kinds of variations that occur in an experiment.   (3 Marks)

c) Explain how you can use principles of design of experiments to get valid assumptions.

(6 Marks)

d) What are the main advantages of a Completely Randomized Design (CRD) (3 Marks).

QUESTION TWO (15 MKS)

a) A researcher calculated the following entries in an analysis of variance table for some data collected from a randomized block design. The average were 30, 25, 50, 40 and 60. The ANOVA was constructed as follows:

SV	Df	Ss	Ms	F
Block	3	360		
Treatment		880		
Residual		35		
Total	20			

i)   Complete the ANOVA table.   (2 Marks)

ii)   Are any entries impossible to determine with information given? Explain (1 Mark)

iii)   How should the experiment be conducted to allow valid conclusions?   (2 Marks)

b) A highway engineer wishes to determine the effect of four types of subgrade soil on the moisture content in the top soil. He takes 5 samples of each type of subgrade soil and the total sum of squares computed was 470 whereas the sum square among four types of subgrade soil was 150.

    i) Set up an analysis of variance table for these results.   (2 Marks)

    ii) Write a mathematical model to describe this problem. Define each term in the model.

                                                                            (2 Marks)

    iii) Formulate the hypothesis you may wish to test in this experiment.   (1 Mark)

c) Define a split plot design   (2 marks)

d) What are the advantages of using a split plot design over a two factor factorial in a completely randomized design?   (3 marks)

SECTION B (39 MKS) ANSWER ANY THREE QUESTIONS

QUESTION THREE (13 MKS)

a) What are the assumptions of ANCOVA   (2 Marks)

b) Analyze the following RBD after estimating the missing value, take $\alpha = 0.01$ (11 marks)

	B1	B2	B3	B4
T1	19	-	23	26
T2	26	28	27	33
T3	20	29	22	26

QUESTION FOUR (13 MKS)

It was suspected that the environmental temperature in which batteries were activated affected their activated life.30 homogenous batteries were tested, six at each of five temperatures and the data shown below were obtained.

Temperature ^0c

	0	20	40	80	146
Activated	30	45	56	63	48
life	28	40	54	62	46
(second)	32	44	52	65	47
	33	46	55	64	44
	32	43	53	61	43
	25	40	54	63	36

   a) Describe the design used in this experiment.   (2 Marks)

   b) When is this design appropriate?   (1 Mark)

   c) Why is this design not widely used in practice? Explain.   (2 Marks)

   d) Construct the analysis of variance of this design and draw statistical inference at 5% level of significance. You may use LSD.   (4 Marks)

   e) Code the above data by subtracting 40. construct ANOVA table.   (3 Marks)

   f) Comment on the results in (a) and in (b) above.   (1 Mark)

QUESTION FIVE (13 MKS)

a) Distinguish between

   (i) Complete and partial confounding   (2 Marks)

   (ii) Complete and incomplete block designs   (2 Marks)

b) Enumerate the main advantages and disadvantages of confounding in an experiment.

(3 Marks)

c) A 2^3 factorial experiment was conducted to investigate how 3 experimental conditions A, B and C were affecting the yields of tomatoes. The following observations were made

Treatment Consumption	Rep 1	Rep 2
I	2	3
a	18	16
b	12	14
c	8	12
ab	6	4
bc	4	4
ac	8	6
abc	3	3

   i) What are the main advantages of factorial experiments?   (1 mark)

   ii) Estimate the main effects   (2 marks)

   iii) If ABC was confounded in two replications, construct ANOVA table.   (3 Marks)

QUESTION SIX (13 MKS)

The table below shows the yields per acre of four different plant crops grown on lots treated with different types of fertilizers.

	Crop 1	Crop 2	Crop 3	Crop 4
Fertilizer A	4.5	6.4	7.2	6.7
Fertilizer B	8.8	7.8	9.6	7.0
Fertilizer C	5.9	6.8	5.7	5.2

Determine at 1% level of significance whether there is a difference in the yields per acre:

   a) Due to fertilizers   (6 Marks)

   b) Due to crops   (7 Marks)

QUESTION SEVEN (13 MKS)

a)

i) Define a balanced incomplete block (B.I.B) design with parameters V,K,r,b and λ (2 marks)

ii) Write parameter relations.   (1 Mark)

b) At a research station an experiment was conducted to study 5 different varieties of tomatoes

V_1, V_2, V_3, V_4 and V_5. The data collected were as follows:

Block 1	$V_1(20)$	$V_2(8)$	$V_3(26)$	$V_4(10)$
Block 2	$V_2(9)$	$V_3(28)$	$V_4(12)$	$V_5(15)$
Block 3	$V_3(30)$	$V_4(9)$	$V_5(16)$	$V_1(21)$
Block 4	$V_4(10)$	$V_5(16)$	$V_1(20)$	$V_2(10)$
Block 5	$V_5(20)$	$V_1(20)$	$V_2(12)$	$V_3(24)$

(i)   Formulate the hypothesis you may wish to test.   (2 Marks)
(ii)   Discuss the assumptions you need to make to analyze the data.   (3 Marks)
(iii) Analyze the data completely at 1% level of significance. You may use LSD test to draw
       statistical conclusions.   (5 Marks)

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