ALUPE UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR

ACADEMICS, RESEARCH AND STUDENTS AFFAIRS

UNIVERSITY EXAMINATIONS

2024/2025 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE IN APPLIED STATISTICS

COURSE CODE: STA 422

COURSE TITLE: **DESIGN AND ANALYSIS OF EXPERIMENT II**

DATE: 10TH JAN, 2025   TIME: 8AM – 11AM

INSTRUCTION TO CANDIDATES

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REGULAR – MAIN EXAM

STA 422: DESIGN AND ANALYSIS OF EXPERIMENT II

STREAM: BSC (Applied Statistics)　　　　　　　　**DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

　i.　*Answer ALL questions from section A and ANY THREE Questions in section B.*

　ii.　*All questions in section B carry Equal Marks.*

　iii.　*Do not write on the question paper.*

SECTION A (31 marks): Answer ALL questions

QUESTION ONE (16MKS)

a)　Outline 5 advantages of factorial design　　　　　　　　　(5 marks)

b)　Explain the meaning of the following in context of experimental design.　　(6 Marks)

　(i) factorial design

　(ii) Factor

　(iii) Main Effect

　(iv) Interaction

　(v) Randomisation

　(vi) Blocking

c)　From the linear additive model for the CRD show that, *Total Sum of Squares = Treatment Sum of Squares + Error Sum of Squares*　　　　　　　(5 Marks)

QUESTION TWO　(15 Marks)

a)　Suppose in an experiment, the values of current and voltage in an experiment affect the rotation per minutes (*rpm*) of fan speed. Suppose there are two levels of current.

　- 5 Ampere, call it as level 1 ( ) C_1 and denote it as a_0

　- 10 Ampere, call it as level 2 ( ) C_1 and denote it as a_1.

　Similarly, the two levels of voltage are

　- 200 volts, call it as level 1 ( ) V_0 and denote it as b_0

- 220 volts, call it as level 2 ( ) V_1 and denote it as b_1.

The two factors are denoted as , A say for current and , B say for voltage.

i.	What is the average effect of voltage for the current level C_0	(2 marks)
ii.	Find the average effect of voltage for the current level C_1	(2 marks)
iii.	Compute the main effect of the voltage	(2 marks)
iv.	Calculate the average interaction effect of voltage and current	(2 marks)
v.	Find the main effect of current	(2 marks)

b) Briefly elaborate the concept of fixed effects and random effect in Completely Randomized Design (5 Marks)

SECTION B (39 MARKS, CHOOSE ANY THREE QUESTIONS)

QUESTION THREE (13 MARKS)

a) Discuss and interpret the 5 conditions of Partially Balanced Incomplete Block Design (PBIBD)

(10 Marks)

b) Below are given the plan and yield in kgs/plot of a 5x5 Latin square experiment on the wheat crop carried out for testing the effects of five, manorial treatments A, B, C, D, and E. 'A'. denotes control.

B 15	A 8	E 17	D 20	C 17	R1 = 77
A 9	D 21	C 19	E 16	B 13	R2 = 78
C 18	B 12	D 23	A 8	E 17	R3 = 78
E 18	C 16	A 10	B 15	D 23	R4 = 82
D 22	E 15	B 13	C 18	A 10	R5 = 78

Analyze the data and state your conclusions. (5 Marks)

QUESTION FOUR (13 Marks)

a) Suppose we conduct a 2^3 factorial experiment in 2^2 blocks of sizes 2 so that three effects are completely confounded with blocks. Suppose two of these are A and ABC. Write the 4 blocks and check if treatment A and ABC together with BC are confounded. (5 Marks)

b) Given the following Grain yield of rice at six seeding rates (Mg/ha) below:

Seeding rate (kg/ha)							
Rep	25	50	75	100	125	150	Y.j
1	5.1	5.3	5.3	5.2	4.8	5.3	31.0
2	5.4	6.0	5.7	4.8	4.8	4.5	31.2
3	5.3	4.7	5.5	5.0	4.4	4.9	29.8
4	4.7	4.3	4.7	4.4	4.7	4.1	26.9
Yi.	20.5	20.3	21.2	19.4	18.7	18.8	118.9
$\sum Y_{ij}^2$	105.35	104.67	112.92	94.44	87.53	89.16	594.07

i. Complete the ANOVA table below   (4 Marks)

SOV	Df	SS	MS	F
Rep	-	-	-	-
Trt	-	-	-	-
Error	-	-	-	
Total	-	-		

ii. Calculate Coefficient of Variation (CV)   (2 Marks)

iii. Calculate LSD   (2 Marks)

QUESTION FIVE (13 Marks)

a) Discuss three principles of experimental designs   (6 Marks)

b) Fill in the given table so the Experimental Error SS = 0.   (7 Marks)

	Treatments				
Rep	A	B	C	D	E
1	2	6	1	8	4
2	4				
3	1				
4	5				

QUESTION SIX (13 Marks)

Given the treatment data below with equal replication:

	Treatment			
Replicate	A	B	C	
1	23	42	47	
2	36	26	43	
3	31	47	43	
4	33	34	39	
yi.	123	149	172	y..=444
$\sum Y_{ij}^2$	3,875	5,805	7,428	

i.   Write the hypotheses to be tested   (1 Marks)

ii.   Calculate the correction factor   (2 Marks)

iii.   Calculate the Total SS   (2 Marks)

iv.   Calculate the Treatment SS   (2 Marks)

v.   Calculate the Error SS   (2 Marks)

vi.   Complete the ANOVA table below   (2 Marks)

Sources of variation	Df	SS	MS	F
Treatment	-	-	-	-
Error	-	-	-	
Total	-	-		

vii.   Make conclusions on the Hypothesis   (1 Marks)

viii. Calculate Coefficient of Variation (CV)   (1 Marks)

QUESTION SEVEN (13 Marks)

Determine if there is a significant interaction between material types and temperature in the data below. Draw the ANOVA table.   (13 marks)

Material type	Temperature					
	15		70		125	
1	130	155	34	40	20	70
	74	180	80	75	82	58
2	150	188	136	122	25	70
	159	126	106	115	58	45
3	138	110	174	120	96	104
	168	160	150	139	82	60