Instructions to Candidates
You should have the following for this examination
-*Answer Booklet, examination pass and student ID*
This paper consists of five questions. Attempt **QUESTION ONE** and any other **TWO.**
Do not write on the question paper.

Question ONE

a. Show If $\underset{\sim}{l}' \underset{\sim}{p}$ is estimable, then there exists a unique linear function $\underset{\sim}{c}' y = c_1 y_1 + c_2 \underset{\sim}{y_2} + ... + c_n y_n$

such that

(i) $E(\underset{\sim}{c}' \underset{\sim}{y}) = \underset{\sim}{l}' \underset{\sim}{p}$

(ii) $\mathrm{var}(\underset{\sim}{c}' \underset{\sim}{y})$ is the least among all unbiased linear estimates of $\underset{\sim}{l}' \underset{\sim}{p}$ (10marks)

b.   A study was conducted to determine the effectiveness of a group stress reduction program based on mindfulness meditation for patients with anxiety disorders. The subjects were selected from those referred to a stress reduction and relaxation program. Rating scale for anxiety at three different points in time is given in the table below. Test the hypothesis that there is a significant difference in mean score across the different times.   (10 marks)

Initial recruitment	Pre treatment	Post treatment	Three month follow up
21	21	16	19
30	38	10	21
38	19	15	6

43	33	30	24
35	34	25	10
40	40	31	30
27	15	11	6
18	11	4	7
31	42	21	27
21	23	16	17
18	24	5	13
28	8	31	2
40	37	23	19
35	32	12	21

c. Explain the assumptions of repeat measures design   (5marks)

d. Explain the disadvantages of a repeat measures design   (5marks)

Question TWO

a.   A study was conducted to examine the characteristics of H-imipramine binding sites in seasonal (SAD) and non-seasonal (non-SAD) depressed patients and in healthy individuals (Control). One of the variables on which they took measurements was the density of binding sites for H-imipramine on blood platelets. The results were as follows

SAD	Non-SAD	Control
634	771	1067
585	546	1176
520	552	1040
525	557	1218
693	976	942
660	204	845
520	807	
573	526	

i. Using the above data can we conclude that there is a difference among population means at 5% level of significance?
(8 marks)

ii. Use Tukey's HSD procedure to test for significant differences among individual pairs of means (6 marks)

b. Obtain the variance of the sum of squares due to a linear function $S^2(\underset{\sim}{c}'\underset{\sim}{y}) = \dfrac{(\underset{\sim}{c}'\underset{\sim}{y})^2}{\underset{\sim}{c}'\underset{\sim}{c}}$ (6 marks)

Question THREE

a. Let y_1, y_2, y_3 be independent observations where

$$E(y_1) = 2p_1 + p_2 + 3p_3$$
$$E(y_1) = p_1 + p_2 + 2p_3$$
$$E(y_1) = 3p_1 + p_2 + 4p_3$$

Determine the condition under which $\underset{\sim}{l}'\underset{\sim}{p} = l_1 p_1 + l_2 p_2 + l_3 p_3$ is estimable (10marks)

b. A study was done to determine the pharmacokinetics of phenytoin in the presence and absence of concomitant fluconazole therapy. Among the data collected during the course of the study were the following trough serum concentrations of fluconazole for 7 healthy male subjects at three different points in time.

subjects	Day 14cmin	Day 18cmin	Day 21cmin
1	8.28	9.55	11.21
2	4.71	5.05	5.20
3	9.48	11.33	8.45
4	6.04	8.08	8.42
5	6.02	6.32	6.93
6	7.34	7.44	8.12
7	5.86	6.19	5.98

Can we conclude that there is a difference in the mean serum concentration among the three days at 5%?
(10 marks)

Question FOUR

a. Obtain the least squares estimate of a Latin Square design   (10 marks)

b. A remotivation team in a psychiatric hospital conducted an experiment to compare methods for remotivating patients. Patients were grouped according to level of initial motivation. Patients in each group were randomly assigned to the five methods.   Patients were grouped according to level of initial motivation. Patients in each group were randomly assigned to the five methods. The patients were assigned a composite score as a measure of his or her level of motivation. The results are as a follows

Level of initial motivation	Remotivation Method				
	A	B	C	D	E
NIL	58	68	60	68	64
VERY LOW	62	70	65	80	69
LOW	67	78	68	81	70
AVERAGE	70	81	70	89	74

Do these data provide sufficient evidence to indicate a difference in mean scores among methods at 5% level of significance?   (10marks)

Question FIVE

a. Explain the assumption of a factorial design (6marks)

b. The following table shows the emotional maturity scores of 27 young adult males cross classified by age and the extent to which they use marijuana

Age	Marijuana usage (factor B)		
(factor A)	Never	occasionally	Daily
15-19	25	18	17
	28	23	24
	22	19	19
20-24	28	16	18
	32	24	22
	30	20	20
25-29	25	14	10
	35	16	8

	30	15	12

At 5% level of significance;

i. Does the mean emotional maturity score differ among different extent of marijuana usage? (6marks)

ii. Does the age group affect the emotional maturity score? (4 marks)

iii. Is there interaction between extent of marijuana usage and age? (4 marks)