MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF APPLIED STATISTICS

MODULE: DESIGN AND DESIGN ISSUES

CODE: ASTA 211

SESSIONAL EXAMINATIONS
APRIL 2023

DURATION: 3 HOURS

EXAMINER: MR ZVAWANDA I

INSTRUCTIONS

1. *Answer **ALL** questions from Section A*
2. *Answer any **three** questions from Section B*

REQUIREMENTS

Statistical tables;
Non-programmable scientific calculator
Graph paper

SECTION A [40 MARKS]

Answer **All** Questions in this Section

A1. Define the following terms as used in design and design issues

i) Experimental design

ii) Randomisation

iii) Replication and

iv) Treatment

[2, 2, 2, 2]

A2

a) Describe a Completely Randomised Designs (CRD) and state the conditions under which it is used.

b) State and explain the 3 advantages and 3 disadvantages of using a Completely Randomised Designs (CRD).

[6, 6]

A3

State the general model of an RBD (Randomised Block Design) and define the parameters. **[5]**

A4

A CRD was used to compare the mileage (km) per litre obtained by 3 competing brands of petrol.15 identical cars were randomly assigned to brands I, II and III, with each brand assigned five cars. The cars were operated under the same conditions and the distance travelled by each car per litre of the assigned brand of petrol recorded. The results are shown in the table below.

Analyse and draw conclusions and test the hypothesis**.**

	Type of Car						
Brand	**1**	**2**	**3**	**4**	**5**	**Total**	**mean**
I	10.5	12	14	16	19	71.5	14.3
II	11.5	13	15	17	11.5	68	13.6
III	11	11.5	14.5	15.5	11	63.5	12.7

[15]

SECTION B [60 MARKS]

*Answer any **THREE** questions in this section*

B5

Consider an experiment to compare the effects of analysts on the DNA concentration of plaque 18 to 20 year old females. Three female subjects (ages 18 to 20 were randomly chosen for the study. Each subject was allowed to maintain her usual diet , supplemented with 30mg of sucrose per day. No toothbrushing or mouth washing was allowed during the study. At the end of the week , a sample of plaque was scrapped from the entire dentition of each subject. Three analysts were randomly chosen, and each given an unmarked sample of plaque from each subject and asked to analyse it for DNA content .The sample data follows. Analyse and draw conclusions.

	Subject			
Analyst	1	2	3	Total
1	13.2	10.6	8.5	32.3
2	12.5	9.6	7.9	30
3	13	9.9	8.3	31.2
Total	38.7	30.1	24.7	93.5

[20]

B6

i) State three merits and the demerits of using a latin square design.

ii) Construct a standard 3X3 latin square design

iii) State the general model for a Latin square experiment with t treatments

iv) What is the purpose of replicating a latin square design

[6, 6, 5, 3]

B7

A supervisor wanted to determine whether or not there is a difference in the number of defective items produced by three different shifts: A, B and C. He suspected that malfunctioning machines and operator errors were also responsible for the production of defective items besides the shifts . In order to get a clear picture about the effects of the shifts on the number of defective items produced he conducted an experiment using a Latin square design with operator and machine as blocking factors. The data collected is shown as below. Analyse the data and draw conclusions

Operator

		1	2	3	Total	Mean
	1	23 (B)	31(C)	51 (A)	105	35
Machine	2	71 (A)	42 (B)	35 (C)	148	39.33
	3	34 (C)	67 (A)	29 (B)	130	43.33
	Total	128	140	115	383	
	Mean	42.67	46.67	38.33		42.55
Shifts		A	B	C		

	Total	189	94	100		
	Mean	63	31.33	33.33		

[20]

B8

a) State two ways which one can use to check Normality assumption

b) A chemical experiment was conducted to determine whether the reaction time was function of the type of catalyst used. A balanced incomplete Randomized block design was used for the experiment. The treatments were four catalysts and the blocks were four batches of raw batches of raw materials. The data are displayed in the table below. Test the equality of the catalyst effects at the 5% level of significance.

	Batch				
Catalyst	1	2	3	4	Total $Y_{i.}$
1	73	74	….	71	218
2	…	75	67	72	214
3	73	75	68	….	216
4	75	….	72	75	222
Total $Y_{j.}$	221	224	207	218	870 Y..

[2, 18]

END OF QUESTION PAPER