GWANDA STATE UNIVERSITY

FACULTY OF LIFE SCIENCES

DEPARTMENT OF CROP SCIENCES

BACHELOR OF SCIENCE (HONOURS) DEGREE IN CROP SCIENCE

STATISTICAL METHODS AND EXPERIMENTAL DESIGNS

LCS 2102

First Semester Examination Paper

January 2022

This examination paper consists of 5 pages

Time Allowed:	**3 hours**
Total Marks:	**100**
Special Requirements:	**To be provided by the Exam department**
	Statistical tables for agriculture students and graph papers
	To be provided by the student
	Non-programmable scientific calculator

Examiner's Name: **R. Mapuranga**

INSTRUCTIONS

1. Answer any **two (2)** questions from Section A and any **three (3)** questions from Section B
2. Start each question on a new page

MARK ALLOCATION

QUESTION	MARKS
EACH QUESTION	20
TOTAL ATTAINABLE MARKS	**100**

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SECTION A: ANSWER ANY TWO (2) QUESTIONS [40 MARKS]

1. (a) Differentiate between the following:

      (i) Problem statement and justification [2]

      (ii) Objectives and hypothesis [2]

      (iii) Introduction and literature review [2]

  (b) In research objectives must be SMART. Expand the acronym SMART and give one example of a SMART objective. [3]

  (c) Given that for a sample size of 16, mean square error (MS_{error}) was 0.0215, calculate the standard error of mean (S.E) [3]

  (d) Discuss the considerations a researcher would keep in mind when constructing an interview schedule for data collection [8]

2. (a) Define the term ethics as used in the research process. List and explain any four (4) ethics in scientific research [5]

  (b) (i) What is the difference between open and closed ended questions? [2]

      (ii) Comment on the use of the two (2) forms of questions in (i) above in questionnaire design [1]

  (c) You are given the following: SED = 0.1037 and error degrees of freedom = 6, calculate least significance difference (LSD). Take alpha to be 0.05. [3]

  (d) Discuss any three (3) types of qualitative data analysis [9]

3. (a) Define the following terms:

      (i) Residual [1]

      (ii) Replication [1]

      (iii) Contingency table [1]

      (iv) Population [1]

      (v) Data [1]

  (b) Outline any three (3) data transformation methods. For each method indicate the scenarios under which their use is appropriate [6]

  (c) State the advantages of using a split plot design over randomized complete block design (RCBD) for a factorial experiment [2]

  (d) Describe how variance is partitioned in an RCBD and hence state the formula for the calculation of residual sum of squares (SS_{error}) [7]

SECTION B: ANSWER ANY THREE (3) QUESTIONS

4. An experiment was set up to test four (4) rates of Zn on cabbage growth and yield. There were three (3) replicates and the experiment was set up as a randomized complete block design. The yields (tons/ha) are given in the table below.

Treatments	Block		
kg Zn/ha	I	II	III
0	3.5	3.8	3.7
5	3.9	4.2	4.4
10	4.0	4.4	4.8
15	4.3	4.2	4.9

Carry out an analysis of variance (ANOVA) for this data set and perform the appropriate F test to determine whether treatment effects had a significant effect on cabbage yield at $P < 0.05$. [20]

5. An agronomist conducted an experiment to compare the yields of 4 varieties of groundnuts (A, B, C, D). A plot of land was divided into 16 subplots (4 rows and 4 columns). The following latin square design was run (Table X). The responses are given in the Table Y.

Table X: Treatment – groundnut variety				Table Y: Response (yield)			
Row	Column I	Column II	Column III	Column IV	II		IV
		Row I	II	III	IV	II	IV
I	C_I	A	B	D	26.7	19.7	29.0	29.8
II	A_{II}	B	D	C	23.1	21.7	24.9	29.0
III	B_{III}	D	C	A	29.3	20.1	29.0	27.3
IV	D_{IV}	C	A	B	25.1	17.4	28.7	35.1

An analysis of variance for this experiment was carried out using Genstat and the partial ANOVA is shown below.

Source	DF	SS	MS	F
Row	……	9.4275	……	……
Column	……	245.9125	……	……
Treatments	……	42.6675	……	……
Error	……	23.9825	……	
Total	……	321.99		

(a) Define the term experimental unit [2]

(b) Copy and complete the ANOVA table [6]

(c) Test the hypothesis that means of all the four varieties are not significantly different at 5% level (H_0: $\mu_A = \mu_B = \mu_C = \mu_D$) and [4]

(d) Test whether the design was effective (i.e. the column have significant different means and rows have significant different means) [8]

6. A laboratory investigation into the physiological responses of Kariba bream to temperature was carried out. Using cameras, the researchers recorded the beat frequency with which the Kariba bream push water over their eggs. The following is the result of this investigation:

	Temperature (°C)					
	10.1	12.2	13.5	11.2	10.2	
Beat frequency (beats/minute)	89.0	94.8	99.6	93.8	91.0	89.2

(a) Plot temperature (x-variable) against beat frequency (y-variable). What assumption for regression is tested by this plot? Is the assumption met? [5]

(b) Find the regression line of temperature and beat frequency [10]

(c) Find the coefficient correlation of temperature versus beat frequency. Comment on the relationship between temperature and beat frequency. [5]

7. An evaluator of an agricultural recovery programme which distributed seed packs to communal farmers wishes to carry out a survey to establish if certain components of the recovery programme were successful.

(a) Differentiate a sampling frame from a sampling unit [2]

(b) What would be the sampling frame and sampling units for the agricultural

recovery programme [2]

(c) Explain how you would get permission to carry out this survey [2]

(d) The following is the data concerning the attendance at four demonstration farm's open days to show how the seed distributed should be cultivated. Using Chi-square test, test to see if there any relationship between the farm and the gender of the people attending the open days.

Farm	Females	Males	Total
Farm 1	367	622	989
Farm 2	471	700	1171
Farm 2	599	682	1281
Total	1437	2004	3441

[14]

End of the Examination Paper