CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

FIRST YEAR EXAMINATION FOR BACHELOR OF SCIENCE IN CHEMISTRY, BACHELOR OF SCIENCE INDUSTRIAL CHEMISTRY AND BACHELOR OF SCIENCE

CHAL 202: STATISTICAL METHODS FOR ENVIRONMENTAL CHEMISTRY II

STREAMS: BSc (Y2S1) **TIME: 2 HOURS**

DAY/DATE: THURSDAY 01/04/2021 **8.30 A.M. – 10.30 A.M.**

INSTRUCTIONS

- ***Answer question one and any two questions***
- ***Use of calculators and statistical tables is allowed***
- ***Do not write on the question paper***

Question one (30 marks) compulsory question

(a) Explain the following terms as used in the design of experiment:

(i) Factor (2 marks)

(ii) Treatment (2 marks)

(iii) Response variable (2 marks)

(iv) Interaction (2 marks)

(v) Randomisation (2 marks)

(vi) Replication (2 marks)

(b) Describe the three step method for achieving robust design. (6 marks)

(c) i) Explain the main purpose of principal component analysis. (2 marks)

ii) Describe the steps in hypothesis testing (4 marks)

(d) Discuss the essential components of the design of an experiment. (6 marks)

Question two (20 marks)

Five laboratories (A,B,C,D and E) determined the concentration of naturally occurring in Cadmium in soils in mg/kg and obtained the following results:

Laboratories	Replicate 1	Replicate 2	Replicate 3	Replicate 4
A	4.4	4.4	3.6	3.4
B	5.8	3.6	4.2	4.0
C	3.4	3.6	3.8	4.6
D	3.2	3.8	3.6	3.6
E	6.0	5.0	4.8	5.4

Perform analyse of variance and test if the five laboratories yields significantly different results. Take $\alpha = 0.05$ (20 marks)

Question three (20 marks)

(a) A full factorial experiment with two factors each at two levels and replicate three times was laid out in Randomised Complete Block Design (RCBD). Generate a plot layout and write down a skeleton of analysis of variance (ANOVA) table. (12 marks)

(b) The following data are measurements of the heparin cofactor II (HCII) to plasma protein ratios in a group of patients at baseline and five months after haemodialysis.

Patient	1	2	3	4	5	6	7	8
Before	2.11	1.85	1.82	1.75	1.54	1.52	1.49	1.44
After	2.15	2.11	1.93	1.83	1.9	1.56	1.44	1.43

Using an appropriate non-parametric procedure, at 5% significance level determine if the two measurements are not significantly different. (8 marks)

Question four (20 marks)

An experiment was set up in a 5 x 5 Latin Square Design (LSD) with the blocking being due to operators and type of materials (values in the parenthesis indicate the response for a given treatment):

	Materials				
Ope	A[24]	B[17]	C[18]	D[26]	E[22]
	B[20]	C[24]	D[38]	E[31]	A[30]
	C[19]	D[30]	E[26]	A[26]	B[20]
	D[24]	E[27]	A[27]	B[23]	C[29]
	E[24]	A[36]	B[21]	C[22]	D[31]

Carry out an analysis of variance and interpret the result. Use $\alpha = 0.05$ (20 marks)

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