



**JARAMOGI OGINGA ODONGA UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

**SCHOOL OF AGRICULTURAL AND FOOD SCIENCES**

**THIRD YEAR FIRST SEMESTER UNIVERSITY EXAMINATION FOR  
THE DEGREE OF BACHELOR OF SCIENCE IN ANIMAL SCIENCE**

**2016/2017 ACADEMIC YEAR**

**REGULAR**

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**COURSE CODE: AAS 3313**

**COURSE TITLE: DESIGN AND ANALYSIS OF ANIMAL EXPERIMENTS**

**EXAM VENUE:**

**STREAM: BSC. (FOOD SECURITY)**

**DATE:**

**EXAM SESSION:**

**TIME: 2 HOURS**

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**Instructions:**

- 1. Answer ALL questions in section A and ANY other 2 Questions in section B.**
- 2. Candidates are advised not to write on question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**SECTION A [COMPULSORY]**

**QUESTION ONE [30 MARKS]**

a. Define the following terms as used in design of experiments

i) Treatment [1 mark]

ii) Experimental unit [1mark]

iii) Interaction effects in a factorial experiment [2 marks]

b. Work out missing values in the following anova table

5 marks

Sources of variation	SS	DF	MSS	F
Treatment	24	-	2.5	-
Block	-	3	21.5	-
Error	-	-		
Total	152	22		

c. Explain the following:

i. Parameter [1 mark]

ii. When statistical data is considered significant [1 mark]

iii. P-value [2 marks]

d. All combinations of 2 levels of a solvents K and P on milk yield were studied. The following were the resultant yields.

	(I)	(K)	(P)	(KP)
1	23	25	22	38
	(P)	(I)	(K)	(KP)
2	40	28	36	38
	(I)	(K)	(PK)	(P)
3	29	20	30	20
	(PK)	(K)	(P)	(I)
4	34	31	24	28

i. Determine the main and interaction effects [3 marks]

ii. Do interaction plots [3 marks]

e. A factorial experiment consists of four factors A, B each at two levels:  $A = \begin{pmatrix} 1 \\ a \end{pmatrix}$ ,  $B = \begin{pmatrix} 1 \\ b \end{pmatrix}$ ,

i. write out all the treatment combinations [3 marks]

ii. Define interaction as used in design of experiments [2 marks]

f. The viscosity of a liquid detergent is supposed to average 800 centistokes at 25°C. A random sample of 16 batches of detergent is collected, and the average viscosity is 812. Suppose we know that the standard deviation of viscosity is  $\sigma = 25$  centistokes.

i. Determine p-value for the test [3 marks]

ii) Test these hypotheses based on p-values at  $\alpha = 0.05$  [3 marks]

## SECTION B: ANSWER ANY TWO QUESTIONS

### QUESTION TWO [20 MARKS]

a.i. Distinguish between complete randomized block designs and complete randomized design [1 mark]

ii) Distinguish between balanced and unbalanced data CRD [2 marks]

b. Four minerals (P,R,S and S) known to improve production were fed to bulls being fattened for slaughter. Increase in weight the animals 3 months later is given in the table below:

P	Q	R	S
58	56	50	52
57	54	54	49
58	57	55	50
55	55	52	51
54	53	51	61

You are required to test if the minerals cause increase in mass.

i) State the appropriate hypotheses [2 marks]

ii) Calculate  $SS_T$ ,  $SS_{Treatment}$  and  $SS_{Error}$  [7 marks]

iii) Calculate the test statistic [2 marks]

iv) Construct the relevant anova table [2 marks]

v) Give your conclusion [3 marks]

**QUESTION THREE [20 MARKS]**

A scientist is interested in the effects of owner (*A*), type (*B*), and housing (*C*) on the growth (in weeks) of chicks. Two levels of each factor [(low= 1) and (high = a, b, c respectively)] are chosen, and three replicates of a factorial design are run.

A	B	C	Treatment	I	II	III
			Combination			
-	-	-		22	31	25
+	-	-		32	43	29
-	+	-		35	34	50
+	+	-		55	47	46
-	-	+		44	45	38
+	-	+		40	37	36
-	+	+		60	50	54
+	+	+		39	41	47

- a. i) Identify the type of design applied in this experiment [1 mark]
- ii) Complete the column for treatment combinations [3 marks]
- b. i) Estimate the main factor effects [8 marks]
- ii) Which effects appear to be large? [2 marks]
- c. Determine contrasts for Interaction effects [6 marks]

**QUESTION FOUR [20 MARKS]**

A router is used to cut locating notches on a printed circuit board. The vibration level at the surface of the board as it is cut is considered to be a major source of dimensional variation in the notches. Two factors are thought to influence vibration: bit size (*A*) and cutting speed (*B*). Two bit sizes (and in.) and two speeds (40 and 90 rpm) are selected, and four boards are cut at each set of conditions shown below.

The response variable is vibration measured as the resultant vector of three accelerometers (*x*, *y*, and *z*) on each test circuit board.

A	B	Treatment combination	Replicate			
			I	II	III	IV
-	-		18.2	19	12.9	14.4
+	-		27.2	24	22.4	22.5
-	+		15.9	15	15.1	14.2
+	+		41	44	36.3	39.9

- a. i) draw the AB interaction plot [4 marks]    ii) Interpret the plot [2 marks]
- b. Estimate the factor effects [8 marks]
- c. Prepare an analysis of variance table and determine which factors are important in explaining yield [6 marks]

### QUESTION FIVE [20 MARKS]

A farmer believes that a certain plant fed to cows has the effect of causing increase or reduction of weight on the cows. She chooses 36 cows, feeds and then monitors their weight for some time. Previous research indicates mean change in weight is 1.5 kg. She finds that the mean change in weight for the sampled cows is 1.8 kg with standard deviation of 0.6 kg. She goes ahead to test her results at  $\alpha = 0.01$ .

- a. i. Write the hypotheses for the farmer [2 marks]
- ii. State whether it is one or two sided test [1 mark]
- iii. Calculate the test statistic [3 marks]
- b. i. Determine the critical value and sketch the rejection region [4 marks]
- ii. Test the hypothesis and make your conclusions [3 marks]
- c. Determine:
- i. the 99% confidence interval for the population mean [3 marks]
- ii. P-value of the test [4 marks]