(*Knowledge for Development*)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2019/2020 ACADEMIC YEAR

SECOND YEAR SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: STA 345

COURSE TITLE: DESIGN AND ANALYSIS OF EXPERIMENTS I

DATE: 12/02/2021 **TIME: 8 AM -10 AM**

INSTRUCTIONS TO CANDIDATES
Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

a) Discuss the assumptions of ANOVA (4mks)

b) Discuss three principles of experimentation. (6mks)

c) In a test given to two groups of students the marks obtained are as follows

Ladies: 18	20	36	50	49	36	34	49	41
Males: 29	28	26	35	30	44	46		

Examine if there is any significant difference between the mean mark scored by the students as the above two groups at 1% level of significance (4mks)

d) Two sources of raw materials are under consideration by a company. Both sources seem to have similar characteristics but the company is not sure of their respective uniformity. A sampleof 10 lots from source A yielded a variance of 225 and a sample of 11 lots from source B yielded a variance of 200. Is it likely that the variance of source A is significantly greater than that of source B at $\alpha = 5\%$ (6mks)

e) A newspaper vendor wanted to test whether or not selling on different days had any impact on the mean amount of newspapers sold. The number of lots sold on a day varied from 1 to 4. The data for one week was as shown below

Monday	3,100	3,300		
Tuesday	4,000			
Wednesday	2,600	2,800	2,900	3,000
Thursday	1,800	2,400		
Friday	1,500			

Taking the level of significance as 5% and assuming normality of the random elements, test the null hypothesis of no difference between the days (14mks)

QUESTION TWO (20 MARKS)

(a) The following table gives the yields per acre piece of land. Four regions were subjected to three new performance enhancing varieties I, II, and III. The output (average number of bags per acre) was recorded:

Regions	Variety I	Variety II	Variety III
North	25	22	29
South	37	35	22
East	34	39	40
West	42	41	39

(i) Based on the above information, construct an ANOVA Table (15mks)

(ii) Test whether there is some significant difference in output within the groups and between the groups. (Take α =0.05) (5mks)

QUESTION THREE (20 MARKS)

a) Analyse the following randomized block design after estimating the missing value at 5% significance level.

	Blocks			
Treatments	1	2	3	4
T_1	9	-	13	16
T_2	16	18	17	23
T_3	10	19	12	16

(10mks

b) In an agricultural station an experiment was performed to determine whether there was any difference in the yield of five varieties of maize. The design adopted was five randomized blocks of five plots each. The yield in kgs per plot obtained in the experiment are given below.

Blocks	Varieties					
	V_1	V_2	V_3	V_4	V_5	**Total**
1	20	13	24	15	10	
2	29	12	18	15	18	
3	46	33	33	21	39	
4	28	35	26	25	22.	
5	34	41	13	48	30	
Total						

Analyse the design and comment on your findings (10mks)

QUESTION FOUR (20 MARKS)

A manufacturer of steel is interested in improving the tensile strength of the product. Product engineers think that tensile strength is a function of the iron concentration in the alloy and that the range of iron concentrations of practical interest is between 5% and 20%. A team of engineers responsible for the study decide to investigate four levels of iron concentration: 5%, 10%, 15%, and 20%. They decide to make up six test specimens at each concentration level, using a pilot plant. All 24 specimens are tested on a laboratory tensile tester in a random order. The data from this experiment are shown in the table below

Hard wood concentration (%)	Observations					
	1	2	3	4	5	6
5	7	8	15	11	9	10
10	12	17	13	18	19	15
15	14	18	19	17	16	18
20	19	25	22	23	18	20

Test at 5% significance level whether or not the hard wood concentration causes a significant difference in the tensile strength. (20mks)

QUESTION FIVE (20 MARKS)

Starting with a linear additive model of the form

$Y_{ij} = \mu + t_i + e_{ij}$, where μ is the grand mean yield

t_i is the i^{th} treatment effect

e_{ij} is the random error effect

show that $S^2_T = S^2_e + S^2_t$, where S^2_T is total sum of squares

S^2_e is sum of squares due to random error

S^2_t is sum of squares due to treatment

and hence show that the mean sum of squares due to random error $(\frac{S_e^2}{N-k})$ is an unbiased estimator of the error variance, δ^2_e (20mks)