(10)

(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2016/2017 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

MATHEMATICS

COURSE CODE: STA 345

COURSE TITLE: EXPERIMENTAL DESIGN I

DATE: 25/09/17 **TIME:** 11.30 AM -1.30 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

a) Define the following terms:

i) Conjecture (1mks)

ii) Treatment (1mks)

iii) Experimental unit (1mks)

b) A plastic manufacturer wanted to test whether or not manufacturing on different days had any impact on the mean tensile strength of a plastic material. The number of lots manufactured on a day varied from 1 to 4 and a single strength determination was made per lot. The data for one week was as shown below

Monday	4,100	4,300		
Tuesday	5,000			
Wednesday	3,600	3,800	3,900	4,000
Thursday	2,800	3,400		
Friday	2,500			

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)

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

	Blocks			
Treatments	1	2	3	4
T_1	19	-	23	26
T_2	26	28	27	33
T_3	20	29	22	26

(13mks)

QUESTION TWO (20 MARKS)

Starting with a linear additive model of the form

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

τ_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)

QUESTION THREE (20 MARKS)

a) Briefly discuss three principles of experimentation (6mks)

b) A manufacturer of paper used for making grocery bags is interested in improving the tensile strength of the product. Product engineers thinks that tensile strength is a function of the hardwood concentration in the pulp and that the range of hardwood concentrations of practical interest is between 5% and 20%. A team of engineers responsible for the study decide to investigate four levels of hardwood 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. (14mks)

QUESTION FOUR (20 MARKS)

a) Highlight the main features of a balanced incomplete block design (5mks)

c) Set up an analysis of variance for the following results in a Latin square design, taking $\alpha = 5\%$. (15mks)

A 10	C 15	B 5	D 4
C 12	B 10	D 4	A 3
B 20	D 10	A 5	C 10
D 10	A 4	C 25	B 12

QUESTION FIVE (20 MARKS)

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	30	23	34	25	20	**132**
2	39	22	28	25	28	**142**
3	56	43	43	31	49	**222**
4	38	45	36	35	32	**186**
5	44	51	23	58	40	**216**
Total	**207**	**184**	**164**	**174**	**169**	898

i) Analyse the design and comment on your findings (15mks)

ii) Obtain the efficiency of this design relative to its layout as CRD (5mks)