JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE ACTUARIAL

3rd YEAR 2nd SEMESTER 2016/2017 ACADEMIC YEAR

REGULAR (MAIN)

COURSE CODE: SAS 308

COURSE TITLE: ANALYSIS OF EXPERIMENTAL DESIGNS 1

EXAM VENUE: **STREAM: (BSc. Actuarial)**

DATE: **EXAM SESSION:**

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (30 MARKS)

a) Explain following terms as used in experimental designs:
   i. Experimental unit.
   ii. Response variable
   iii. Treatment (3marks)

b) The following table gives the retail prices of a commodity in some shops selected at random from four towns. Due to government policies, it is assumed that the shops should on average operate at the same retail price. In the process of collecting the data, some shops were found closed. Carry out ANOVA to test the significance of the difference between the prices of the commodity in the four towns at 5% level. State clearly the test hypothesis. (6 marks)

TOWN	**PRICES OF COMMODITY**			
A	22	24	-	23
B	20	-	23	22
C	19	17	21	25
D	-	-	26	24

c) A company selling coffee appoints four salesmen A,B,C and D and observes their sales in three seasons, summer, winter and monsoon. The figures in kilograms are given below.

	salesman			
Season	A	B	C	D
Summer	30	25	33	20
Winter	28	26	31	35
monsoon	32	30	32	32

   i. Describe briefly two important properties of the experimental design that has been used in the summary of this survey. (3 marks)
   ii. Carry out an analysis of variance and comment on your results. (7 marks)

d) Consider a one way classification $y_{ij} = \mu + t_i + e_{ij}$, where y_{ij} is the j^{th} observation on the i^{th} treatment $i = 1,2, \ldots k$ and $j = 1,2, \ldots, n_i$. Citing assumptions, partition the overall sum of squares in to appropriate components. (6marks)

e) Construct two orthogonal Latin Squares L_2 and L_3 given $s = p = 5$ (5marks)

QUESTION TWO (20 MARKS)

a) A set of combinations of five different UREA fertilizers A,B,C,D and DAP fertilizers P,Q,R,S,T applied to 25 plots as shown in the experimental unit below. By stating clearly the hypotheses that one could test, carry out ANOVA at 5% level of significance. (12marks)

AP 15	BQ 10	CR 11	DS 10	ET 9
BQ 11	CR 9	DS 13	ET 11	AP 10
CR 16	DS 7	ET 9	AP 10	BQ 17
DS 13	ET 8	AP 12	BQ 12	CR 13
ET 12	AP 10	BQ 11	CR 8	DS 12

b) An investigator carried out an experiment using a randomized complete block design with V treatments $i = 1,2,3, \dots, V$ and B blocks $= 1,2,3, \dots, b$. Before he could conclude his study, one subject disappeared and no observation could be made on him. Let the missing observation be X. Derive an equation from which X may be estimated. (8marks)

QUESTION THREE (20 MARKS)

a) Consider a randomized complete block design modeled as
$y_{ij} = \mu + t_i + b_j + e_{ij}$
   i. Briefly describe characteristics of this design. (3marks)
   ii. Stating all necessary assumptions, derive the estimates of the model parameters hence show clearly how one may partition the sum of squares due to total variation into desired component sum of squares. (9marks)

b) An investigator wishes to study the effect of four different drugs on pain alleviation. He administered each drug at random to 12 patients with similar complaints and of the same age bracket. Each drug was randomly given to 3 of the twelve patients and the response to pain alleviation recorded as shown in minutes.

Drug	Observation		
A	30	25	20
B	28	26	31
C	35	32	30
D	29	26	25

By stating the hypothesis clearly, analyze the effect of drug on pain alleviation at 5% level of significance. (8marks)

QUESTION FOUR (20 MARKS)

a) Explain the following terms as used in factorial designs:
   i. Orthogonallity
   ii. 2^k factorial design
   iii. Geometric notation
   iv. Interaction factor (8marks)

a) Analyze the design below by computing the sum of squares and showing a summary in ANOVA table.

treatment	replicates
I	10, 12, 8
a	11, 8, 12
b	9, 8, 11
ab	12, 13, 10
c	11,10, 9
ac	8, 9, 12
bc	10, 8, 9
abc	16, 14, 12

(12 marks)

QUESTION FIVE (20 MARKS)

a) The number of automobiles arriving at three gasoline stations was recorded for four days between 8am and 12 noon as follows.

		STATION	
DAY	**1**	**2**	**3**
Tue	45	51	46
Wed	51	47	53
Thur	48	53	42
Fri	50	-	48

Determine whether the rate of arrival is essentially the same at all stations. (10marks)

b) Suppose V treatments are arranged in a VxV Latin square. Let y_{ijk} denote the observation on the k^{th} treatment in the i^{th} row and j^{th} column. Suppose this design assumes a linear additive model $y_{ijk} = \mu + r_i + c_j + t_k + e_{ijk}$, by stating all possible assumptions, obtain the least square estimates of, $\mu, r_i, c_j,\ and\ t_k$ (10marks)