# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND PHYSICS

## UNIVERSITY EXAMINATION FOR:

AMA 5110: DESIGN AND ANALYSIS OF EXPERIMENT

END OF SEMESTER EXAMINATION

**SERIES:** MAY 2016

**TIME:** 3 HOURS

**DATE:** MAY

**Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of five questions, ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.

**Do not write on the question paper.**

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**Question ONE**

a. Determine the condition under which the linear function $\underset{\sim}{l}' \underset{\sim}{p}$ is estimable (5 marks)

b. The compressive strength of concrete is being studied, and three different mixing techniques are being investigated. The following data have been collected.

| Air voids | Retain strength | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Low | 106 | 90 | 103 | 90 | 79 | 88 | 92 | 95 | |
| Medium | 80 | 69 | 94 | 91 | 70 | 83 | 87 | 83 | |
| High | 78 | 80 | 62 | 69 | 69 | 76 | 85 | 69 | |

i. Test the hypothesis that mixing techniques affect the strength of the concrete at 5% level of significance (8 marks)

ii. Using Tukeys test, perform a post ANOVA analysis (7marks)

c. Explain the assumptions of a factorial design (5marks)

d. Explain the advantages of repeat measures design. (5marks)

## Question TWO

a. A study was done to evaluate the effects of chewing gum on tic frequency in patients whose tourette's disorder was inadequately controlled by haloperidol. The following are the tic frequencies under four conditions

| Number of Tics During 30-minute period after end of chewing | | | | |
|---|---|---|---|---|
| Patient | Baseline | Gum chewing | 0-30 mins after end of chewing | 30-60 mins after end of chewing |
| 1 | 249 | 108 | 93 | 59 |
| 2 | 1095 | 593 | 600 | 861 |
| 3 | 83 | 27 | 32 | 61 |
| 4 | 569 | 363 | 342 | 312 |
| 5 | 368 | 141 | 167 | 180 |
| 6 | 326 | 134 | 144 | 158 |

Prepare the ANOVA table (10 marks)

b. Let $y_1, y_2, y_3$ be independent observations where

$E(y_1) = 2p_1 + p_2 + 3p_3$

$E(y_1) = p_1 + p_2 + p_3$

$E(y_1) = 3p_1 + 2p_2 + 4p_3$

Determine the condition under which $\underset{\sim}{l}' \underset{\sim}{p} = l_1 p_1 + l_2 p_2 + l_3 p_3$ is estimable (10marks)

## Question THREE

a. A study was done to quantify the effect of cigarette smoking on standard measures of lung function in patients with idiopathic pulmonary fibrosis across different age groups. Among the measurements taken were percent predicted residual volumes. The results by smoking history were as follows

| Age group | Never | Former | Current |
|---|---|---|---|
| 10-15 | 35 | 62 | 95 |
| 16-20 | 120 | 73 | 107 |
| 20-25 | 90 | 60 | 63 |
| 26-30 | 109 | 77 | 134 |

| | | | |
|---|---|---|---|
| 30-35 | 82 | 52 | 140 |
| 36-40 | 40 | 115 | 103 |
| Above 40 | 68 | 82 | 158 |

i. Using the above data can we conclude that there is a difference among population residual means at 5% level of significance in terms of smoking history? (7 marks)

ii. Use Tukey's HSD procedure to test for significant differences among individual pairs of means (6 marks)

b. Consider the model $\underset{\sim}{y} = A'P + \varepsilon$ obtain the least squares estimate of $\underset{\sim}{p}$ (7 marks)

## Question FOUR

a. State the principle of randomization and explain its importance (10 marks)

b. A study was done on the respiratory effects of exercise and various degrees of airway resistance. The five subjects who were healthy nonsmoking men, engaged in prolonged submaximal exercise while breathing through different flow resistive loads. The results are given in the table below contains the inspired ventilation values

| Subjects | Time in interval | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 40 | 37 | 40 | 40 | 38 |
| 2 | 45 | 41 | 44 | 44 | 45 |
| 3 | 33 | 34 | 34 | 34 | 33 |
| 4 | 38 | 36 | 40 | 35 | 38 |
| 5 | 40 | 42 | 37 | 40 | 42 |

Can we conclude that there is a difference in the mean inspired ventilation values at five successive points in time at 5%? (10 marks)

## Question FIVE

a. Explain the concept of missing plot technique (10 marks)

b. A fumigation experiment was carried out on a strip of land at Rothasmted. Preliminary examination had shown it to be infested with wire worms and the efficacy of the following was to be compared: Chlorodinitobenzene (N), Chloropicrin (P), o-and p-dichlorobenzene (K) and Sodium cyanide and anhydrous magnesium sulphate (M). It addition it was decided to have some plots without fumigants to serve as control. This was denoted as O (no treatment). The land was ploughed and cultivated for sowing with sugar beet. The

experimental plots were arranged in a Latin Square Design but with blocks laid end to end. The four treatments and the control were each replicated five times. Sampling was done nine weeks after fumigation. The table below gives the total count of wire worm per plot and the layer out of the Latin Square design used.

| | | | | |
|---|---|---|---|---|
| P 6 | O 2 | N 29 | K 8 | M 17 |
| M 8 | K 13 | O 18 | N 12 | P 16 |
| O 16 | M 12 | K 7 | P 10 | N 28 |
| N 14 | P 11 | M 13 | O 22 | K 7 |
| K 7 | N 26 | P 24 | M 14 | O 20 |

Obtain The ANOVA table and interpret the table (10 marks)