MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
FIRST SEMESTER EXAMINATION FOR DIPLOMA IN CIVIL ENGINEERING AND DIPLOMA IN BUILDING TECHNOLOGY (MODULE III)

2705/301 & 2707/301: MATHEMATICS III AND SURVEYING III

Date: **Time:**

INSTRUCTIONS:

1. ***This paper comprises of Seven Questions in two sections A and B***
2. ***Answer Five Questions choosing at least Two Questions from each section. Marks for each question is as shown***
3. ***You must have the following items for this paper:***
   - ***Scientific calculator.***
   - ***Statistical tables.***

SECTION A: MATHEMATICS III

Answer at least TWO questions from this section

1. (a) With the aid of diagrams, differentiate between positive correlation and negative correlation as used in statistics. (8 *marks*)

(b) Following the collapse of several residential buildings in Kenyan towns, two structural engineers Makau and Musyoka were assigned the task of assessing residential buildings in Machakos Town and award points in the range 0 to 100 to each building to reflect its conformity to engineering standards. A random sample of 12 buildings was taken and the points were as shown in the table below:

Building	A	B	C	D	E	F	G	H	J	K	L	M
Mutua	47	21	35	87	78	63	08	72	12	84	35	56
Mutisya	34	18	45	83	92	45	15	80	06	67	45	68

(i) Compute the Spearman's *rank co-efficient of correlation* between the points awarded by the two engineers. (8 *marks*)

(ii) What conclusions can you draw from the result obtained in (i) above. (4 *marks*)

2. (b) An agricultural scientist carried out a study on the relationship between crop yield and amount of fertilizer. A random sample of 10 farms in different counties in Kenya was taken. The data given below shows the amount of fertilizer in bags and the crop yield in sacks produced.

Farm	A	B	C	D	E	F	G	H	J	K
Fertilizer	15	12	8	10	16	10	18	9	24	14
Crop yield	55	45	45	50	80	40	65	35	75	70

(i) Determine the *least squares regression line* of the crop yield on the amount of fertilizer used. (10 *marks*)

(ii) Interpret the least squares regression line obtained in (i) above. (4 *marks*)

(iii) Using the regression line obtained in (i) above, estimate by calculation the number of sacks of crop yield produced from a typical farm in which 20 bags of fertilizer was used. (2 *marks*)

(iv) The Pearson's product moment co-efficient of correlation between amount of fertilizer and crop yield is computed and found to be 0.80474647. Compute the co-efficient of determination between the crop yield and the fertilizer and interpret the result. (4 *marks*)

3. (a) A livestock survey conducted by an agricultural researcher among a random sample of 500 pastoralists in Narok County about the keeping of cattle, goats and sheep yielded the following information about livestock keeping:

- 200 pastoralists keep cattle
- 244 pastoralists keep goats
- 172 pastoralists keep sheep
- 92 pastoralists keep cattle and goats
- 80 pastoralists keep cattle and sheep
- 84 pastoralists keep goats and sheep
- 96 pastoralists did not keep any of the three types of livestock

(i) Present this information in a Venn diagram. (6 *marks*)

(ii) Determine the number of pastoralists in the study who keep:

I. exactly one type of animal;

II. goats or sheep but not cattle;

III. goats and sheep but not cattle. (6 *marks*)

(b) A committee of 8 members is to be formed from a group of 10 men and their wives. Determine the number of ways in which the committee can be constituted if:

(i) A man and his wife cannot both serve in the same committee; (6 *marks*)

(ii) A man and his wife cannot both serve in the same committee and each sex must be at least one third of the other to ensure gender representation. (2 *marks*)

SECTION B: SURVEYING III

ANSWER AT LEAST TWO QUESTIONS FROM THIS SECTION

4. a) Derive the trapezoidal formula for area calculation (7 marks)

b) The table below shows offsets taken from a straight boundary to a curvilinear one. Using the trapezoidal formula, calculate the area of the land.

Distance (m)	0	20	40	60	80	100	120	140
Offset	50	140	130	170	230	210	150	90

(5 marks)

c) Calculate the area of a parcel of land whose corner coordinate are as follows

POINT	**N (m)**	**E**
A	1700.00	1500.00
B	1200.00	1900.00
C	900.00	1300.00

(8 marks)

5 a) Highlight five methods used for computing areas of earthwork in any surveying work (5 marks)

b) The table below shows tachometric observations taken at point K with the instrument height being 1.30 m. the tachometric constants were 100 and 0 and the distance LM was measured as 160.05 m. assuming that the ground was level within triangle KLM and the reduced level of point K was 1500.00 m above datum, calculate the volume of filling required to make the area level with the highest point.

Instrument at	Staff station	Staff readings (m)			Vertical angle
		Bottom	Middle	Top	
K	L	1.79	3.04	4.29	+ 12°21′00″
	M	2.39	3.13	3.87	- 6°11′00″

(15 marks)

6 a) State four instruments used for tachometric surveying (4 marks)

b) Describe three sources of errors in horizontal distances determined tachometrically giving relevant examples in each case (6 marks)

c) With the aid of a sketch derive the tachometric formulae for determining horizontal distance and the difference in height between two points when the staff is held vertical and the line of sight inclined upwards. (10 marks)

7 a) Outline three systems of tachometry (3 marks)

b) The table below shows tachometric observations on an inclined staff at stations P and T. The co-ordinates of the instrument station are; (+ 1540.00 mN, - 1075.00 mE). If the tachometric constants are 100 and 0, determine;

(i) The co-ordinates of P and T

(ii) Difference in height between P and T

Staff station	Bearing	Vertical angle	Stadia readings (m)		
P	300°30′ 40″	+ 14°10′ 00″	1.28	1.83	2.50
T	180°40′ 20″	- 8° 40′ 00″	2.20	2.60	3.46

(17 marks)

Statistical Formulae

Pearson's product moment correlation co-efficient r

$$r_{xy} = \frac{\sum xy - n\,\bar{x}\,\bar{y}}{\sqrt{\sum x^2 - n\bar{x}^2} \times \sqrt{\sum y^2 - n\bar{y}^2}} = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2} \times \sqrt{n\sum y^2 - (\sum y)^2}}$$

Spearman's rank correlation co-efficient r_R

$$r_R = 1 - \frac{6\,\sum (R_x - R_y)^2}{n(n^2-1)} = 1 - \frac{6\,\sum (R_y - R_x)^2}{n(n^2-1)}$$

Regression co-efficient b for regression line of y on x

$$b = \frac{\sum xy - n\,\bar{x}\,\bar{y}}{\sum x^2 - n\bar{x}^2} = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

Regression intercept a for regression line of y on x $\quad a = \bar{y} - b\,\bar{x}$

Binomial probability density function $\quad f(x) = \binom{n}{x} p^x q^{n-x}$

Mean = E[X] = n p and var (x) = n p q

Poisson probability density function $\quad f(x) = \frac{\lambda^x e^{-\lambda}}{x!}$ Mean = n p = λ and var (x) = λ

The standardised value z for a normal random variable x: $\quad z = \frac{x - \mu}{\sigma}$

The test statistic z for population mean μ: $\quad z = \frac{\bar{x} - \mu}{S_{\bar{x}}} = \frac{\bar{x} - \mu}{\left(\frac{s}{\sqrt{n}}\right)}$

Confidence limits for population mean μ: $\quad \mu = \bar{x} \pm Z_{\alpha/2}\, S_{\bar{x}} = \bar{x} \pm Z_{\alpha/2} \frac{s}{\sqrt{n}}$

The test statistic t for population mean μ: $\quad t = \frac{\bar{x} - \mu}{\left(\frac{s}{\sqrt{n}}\right)}$,

Confidence limits for population mean μ: $\quad \mu = \bar{x} \pm t_{\propto/2,(n-1)} s_{\bar{x}} = \bar{x} \pm t_{\propto/2,(n-1)} \frac{s}{\sqrt{n}}$

Test statistic z for proportion $\quad S_p = \sqrt{\frac{p\,q}{n}}, \quad z = \frac{\hat{p} - p}{S_{\hat{p}}} = \frac{\hat{p} - p}{\sqrt{\frac{p\,q}{n}}},$

Confidence limits for population proportion p: $\quad p = \hat{p} \pm z_{\alpha/2}\, S_{\hat{p}} = \hat{p} \pm z_{\alpha/2} \sqrt{\frac{p\,q}{n}}$