MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2014/2015

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

Examination for Diploma in Building Technology Module III
Diploma in Civil Engineering Module III

2705/3, 2707/301: MATHEMATICS III AND SURVEYING III

Date: 17/03/2015 **Time: 08:30 – 11:30 am**

Instructions:

- *You should have the following for this examination*
  - *Answer booklet*
  - *Scientific Calculator*
- *This paper comprises of **Eight** questions in **Two** sections **A** and **B***
- *Answer **Five** questions taking **at least Two** questions from each section. All questions carry equal marks*

SECTION A: MATHEMATICS III

*Answer at least **TWO** questions from this section*

1. (a) A structural engineer claims that only 40% of the buildings in Masaku County are built according to engineering standards. Assuming that this claim is true, determine the probability that among 12 buildings randomly selected from Masaku County, the following are built according to engineering standards:

   (i) exactly 4 buildings;

   (ii) between 4 and 6 inclusive;

   (iii) at least 3 buildings. (8 mark*s*)

(b) Research findings suggest that the heights of adult male residents in Masaku County fit a normal distribution with mean 175 cm and standard deviation 8 cm.

(i) Determine the proportion of the male residents with height greater than 180 cm. (3 marks)

(ii) Determine the proportion of the male residents with height between 163 cm and 181 cm. (5 marks)

(iii) A standard needs to be set for the height of doors prepared and sold in the county. Determine the maximum height which must be set for the doors if it is required that 95% of the male residents must be able to pass through without stooping. (4 marks)

2. (a) 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
Makau	47	21	35	87	78	63	08	72	12	84	35	56
Musyoka	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. (9 marks)

(ii) What conclusions can you draw from the result obtained in (i) above. (3 marks)

(b) It is known that 10% of the building contractors in Masaku County are not registered with the professional body. Determine the probability that among a random sample of 200 building contractors selected from the county:

(i) exactly 15 are not registered;

(ii) at least 3 are not registered;

(iii) between 10 and 12 inclusive are not registered. (8 marks)

3. (a) Differentiate between *positive correlation* and *negative correlation* as used in statistics. (2 marks)

(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. (8 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)

4. (a) Highlight **two** conditions which must be satisfied for a probability distribution to be considered binomial. (4 marks)

(b) It is known that 8% of the items coming out of a certain manufacturing process are defective. Determine the probability that among 225 items randomly selected from the manufacturing process:

(i) at least 3 are defective;

(ii) between 4 and 6 inclusive are defective. (6 marks)

(c) It is known from experience that 5% of certain articles produced by a certain machine are defective and have to be discarded. An operator has produced 600 articles on the machine. Determine the 95% and the 99% confidence intervals for the number of defective items produced. (4 marks)

(d) A paint manufacturing factory produces and packages paint in tins which are labelled with a capacity of 1000 litres. The Kenya Bureau of Standards took a random sample of 396 such tins and found them to have a mean capacity of 998 litres and a standard deviation of 20 litres. If the tins have less capacity, then the consumer is exploited while if they have excess capacity, then the factory's objective to maximise profit is not met. Test whether the 1000 litres label on the tins is true at the 5% level of significance. (6 marks)

SECTION B: SURVEYING III

*Answer at least **TWO** questions from this section*

5 a) State four instruments used for tacheometric surveying (4 marks)

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

c) With the aid of a sketch derive the tacheometric 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)

6 a) Outline three systems of tacheometry (3 marks)

b) The table below shows tacheometric bookings to observations on an inclined staff at stations K and L. The co-ordinates of the instrument station are; (+ 1440.00 mN, - 875.00 mE). If the tacheometric constants are 100 and 0, determine;

(i) The co-ordinates of K and L

(ii) Difference in height between K and L

Staff station	Bearing	Vertical angle	Stadia readings (m)
K	303°44′ 20″	+ 12°12′	1.08 1.63 2.52
L	190°58′ 40″	- 8° 24′	2.00 2.67 3.49

(17 marks)

7 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	120	240	360	480	600	720	840
Offset	5	14	13	17	23	21	15	9

(5 marks)

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

POINT	**N (m)**	**E**
A	1730.00	1580.00
B	1200.00	1930.00
C	940.00	1390.00

(8 marks)

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

b) The table below shows tacheometric observations taken at point P with the instrument height being 1.55 m. the tacheometric constants were 100 and 0 and the distance RS was measured as 144.92 m. assuming that the ground was level within triangle PRS and the reduced level of point P was 1000.00 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	
P	R	1.79	3.04	4.29	+ 10°21′
	S	2.39	3.13	3.87	- 8°11′

(15 marks)