THE KENYA POLYTECHNIC UNIVERSITY COLLEGE

DEPARTMENT OF SURVEYING & MAPPING

HIGHER DIPLOMA IN LAND SURVEY

END OF YEAR I EXAMINATIONS

NOVEMBER 2007

SURVEY ADJUSTMENT

3 HOURS

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination:

Answer booklet

Scientific calculator

Answer any **FIVE** of the following **EIGHT** questions.

All questions carry equal marks and the maximum marks for each part of a question are as shown.

This paper consists of **4** printed pages.

1. (a) Explain the purposes of adjustment in Survey measurements. (4 marks)

   (b) Discuss the characteristics that distinguish systematic errors from random errors giving an example of each type of error. (8 marks)

   (c) Distinguish between:

   (i) Precision and accuracy

   (ii) True value and most probable value (MPV) (8 marks)

2. (a) State the basis of linearization. (2 marks)

   (b) Explain error propagation as used in adjustment of survey adjustments. (3 marks)

   (c) The triangular parcel of land ABC shown in figure 1 has dimensions AB=100.00m, BC=80.00m and CA=110.00m. The parcel is divided in two parts I and II as shown, by setting D on AB at a distance "x". Evaluate the resulting error in the area of I if x has an error 0.020m. (15 marks)

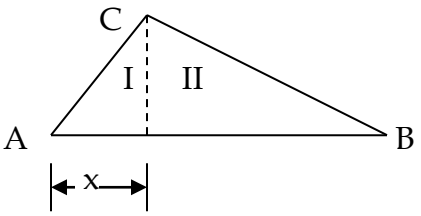

Figure 1

3. Figure 2 shows a plane rectangular coordinate system. α_{ij} and S_{ij} are the measured bearing and distance respectively.

   (i) Establish the functional relationships between the coordinates of the point *i* and the observations.

   (ii) Evaluate the Jacobian matrix at $\alpha_{y0} = 30^0 00' 00''$ and $S_{ij0} = 1000.00m$. (20 marks)

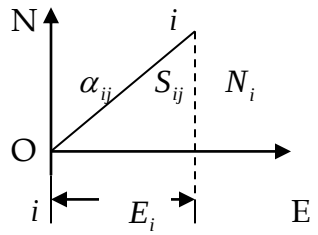

Figure 2

4. (a) Explain the following terms giving mathematical functions underlying each case:

   (i) Arithmetical mean (ii) Variance

(iii) Standard deviation (9 marks)

(b) An observer measured a distance ten times with an EDM under the same conditions. The results of the observations agreed in meters (126m) but differed in decimals as follows: .351, .345, .348, .350, .348, .352, .345, .348, .342 and .349. Calculate:

(i) The most probable value

(ii) The standard deviation

(iii) The standard error of the mean. (11 marks)

5. (a) Explain why redundancy is necessary in survey measurements. (6 marks)

(b) Outline characteristics that distinguish observation and condition equation methods of least squares adjustment. (6 marks)

(c) Coordinates of three points of straight line are shown in table 1. Write down the observation equations indicating the dimensions of the matrices.

Table 1

POINT	X	Y
1	2	3.2
2	4	4.0
3	6	5.0

(8 marks)

6. Show that the least squares estimate of a quantity from uncorrelated measurements ($x_1, x_2, \ldots x_n$) of weight ($w_1, w_2, \ldots, w_n$) is given by:

$$\bar{x} = \left(\sum_{i=1}^{n} w_i x_i\right) \Big/ \sum_{i=1}^{n} w_i$$

(20 marks)

7. Figure 3 shows three observed angles whose values are shown in table 2.

Table 2:

Angle	Observation	Weight
BAC	$62^0 18' 10''$	1
CAD	$26^0 34' 40''$	2
BAD	$88^0 52' 40''$	6

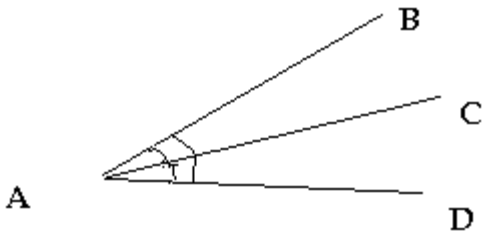

Figure 3

If the observations are uncorrelated, calculate the most probable value of the angles using condition equation method. (20 marks)

8. In the levelling network shown in figure 4, five independent lines were levelled by spirit levelling. The values of the height differences are shown in table 3.

Line	From	To	Difference in height (m)
l_1	A	B	20.17
l_2	B	C	5.17
l_3	C	D	9.97
l_4	B	D	15.49
l_5	D	A	-35.36

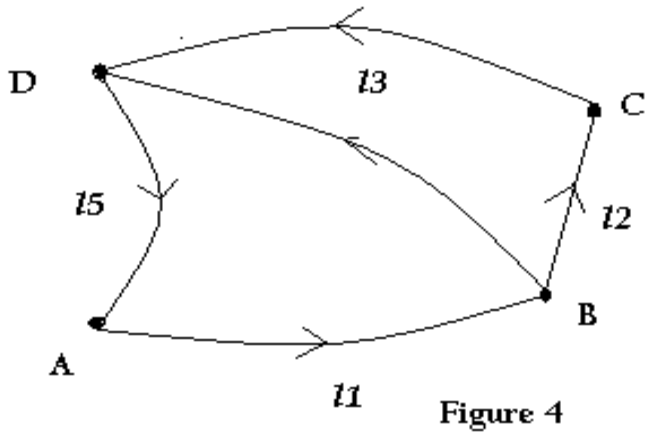

Figure 4

The elevation of the fixed point A is 700.00m.

(i) Form the observation equations for least squares solution for elevations of point B, C and D.

(ii) Obtain the normal equations that will lead to the least squares solution. (20 marks)