# The Open University of Sri Lanka
# Faculty of Engineering Technology

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| Study Programme | : Bachelor of Science in Engineering |
| Name of the Examination | : Final Examination |
| **Course Code and Title** | **: CVX 4342 – Surveying 1** |
| Academic Year | : 2023/24 |
| Date | : 03rd March 2025 |
| Time | : 0930 -1230 hrs |
| Duration | : **3 hours** |

**General Instructions**

1. Read all instructions carefully before answering the questions.
   1. This question paper consists **of Seven (7)** questions
   2. Answer **for any five(05) questions**
   3. Answer for each question should commence from a new page.
   4. This is a Closed Book Test (CBT).
   5. Answers should be in clear handwriting.
   6. Do not use Red colour pen.

**Question 1**

1. What is the main purpose of "Working from Whole to parts" in most types of surveys? (03 marks)
2. The length of **a rectangular shape land** is 22.1m. The area of the land is 15.5 perch. Calculate the width of the land that shall be marked in a plan if the scale of the plan is 1:500. (04 marks)
3. A steel tape has been used to measure a chain line. The measuring was carried out by three spans and measured lengths are 29.900m , 29.985m and 17.835m. All measurements were taken at a temperature of $30^0$C and the temperature at which the tape had been standardized is $22^0$C. The first two measurements were taken under the standard pull of 15kg and the last reading was taken under a pull of 18kg. There is no standardization error in this tape. Following are some material properties of the tape – $E_{tape}$= 17200kg/mm$^2$,weight per unit length of the tape = 0.03kg/m, Cross sectional area of the tape=3.05mm$^2$ , $\alpha_{tape}$= 13 x$10^{-6}$ per $^0$C.
   Calculated the corrected length. (08 marks)
4. In Figure 1, AD is a chain line of a chain survey. However, the establishment of line AD has been obstructed by a building as shown in Figure 1. Hence, length AB, BD and BE were measured. CE and AB are perpendicular to the line AD.

AB = 8.21m, BD = 17.1m and BE = 11.35m. Calculate length AC. (05marks)

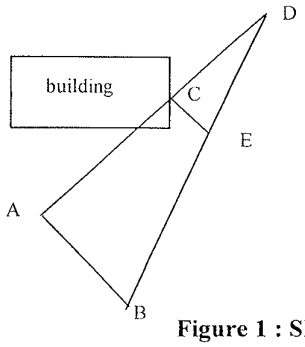


**Figure 1 : Sketch of the site**

## Question 2

1. (a) Table 1 shows recorded readings of levelling work. Calculate reduced levels of all stations using a standard method. Reduced level of station O is 250.000m. All error checking relevant that method shall also be performed. (10 marks)

**Table 1 : Recorded readings of levelling work**

| Backsight | Inter sight | Foresight | Station |
|---|---|---|---|
| 2.575 | | | O |
| | 1.835 | | A |
| | 1.325 | | B |
| 1.565 | | 3.255 | C |
| | 2.550 | | D |
| | 3.125 | | E |
| 3.625 | | 2.285 | F |
| | | 1.775 | G |

(b) If the station G is a bench mark and actual reduced level of G is 250.495 m, calculate the error of this levelling exercise. (02 marks)

2. How do you ensure the verticality of a staff when you are taking a level reading? Briefly explain. (04 marks)

3. Deck bottom of a bridge was selected as a benchmark for a levelling work. The reduced level of that benchmark was 70.000m. A reading was taken while holding the staff at an **inverted** position on that benchmark. The recorded reading was 2.525m. Another reading was taken for point "X" while holding the staff in normal way without changing the instrument height. If the recorded reading at that point is 1.575m, calculate the reduced level of point "X". (04 marks)

## Question 3

1. Table 2 shows observed included angle readings obtained during a closed traverse survey using a theodolite. Copy down the given table and complete it to obtain Whole Circle Bearing (WCB) of all lines. The WCB (clockwise) of line KL is $25.55^0$. Error checking and distribution of errors (if any) shall be done prior to calculation of WCB. (10 marks)

Table 2: WCB calculation table

| station | Line | Observed included angle | | | Corrected included angle | | | Corrected included angle (in degrees) | WBC (in degrees) |
|---|---|---|---|---|---|---|---|---|---|
| | | DEG | MIN | SEC | DEG | MIN | SEC | | |
| K | | 105 | 9 | 45 | ..... | ..... | ..... | ..... | |
| | KL | | | | | | | | 25.5500 |
| L | | 29 | 13 | 0 | ..... | ..... | ..... | ..... | |
| | LM | | | | | | | | ..... |
| M | | 146 | 15 | 15 | ..... | ..... | ..... | ..... | |
| | MN | | | | | | | | ..... |
| N | | 79 | 22 | 30 | ..... | ..... | ..... | ..... | |
| | NK | | | | | | | | ..... |
| | | | | | | | | | |

2. Table 3 shows a part of table developed to calculate coordinates of a traverse survey. Corrected WCB (**after making angular correction**) have been given, and you are required to calculate coordinates of the traverse point Y and Z. The coordinates of X can be taken as (500.00, 500.00). calculate the coordinates by completing the Table 3 in your answer paper. To obtain corrected coordinates, adjustment of coordinates shall be done using an standard method. (10 marks)

Table 3: Coordinate calculation table

| | Traverse legs | length (m) | Corrected WCB | Latitude | | Departure | | Corrected Latitude | | Corrected Departure | | Coordinates | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | North | South | East | West | North | South | East | West | N | E |
| X | | | | | | | | | | | | 500.00 | 500.00 |
| | XY | 54.984 | 68 15' 45" | | | | | | | | | | |
| Y | | | | | | | | | | | | | |
| | YZ | 116.050 | 192 45' 45" | | | | | | | | | | |
| Z | | | | | | | | | | | | | |
| | ZX | 97.125 | 344 37' 15" | | | | | | | | | | |
| X | | | | | | | | | | | | | |

## Question 4

1. Briefly explain the term "Tacheometry" in surveying and name two tacheometry systems used in surveying except Tangential system. (04 marks)
2. Derive the principal equation relevant to **Tangential system** of tacheometry to obtain distance between instrument station and staff. ( 06 marks)
3. It was obtained following readings in a Stadia tacheometry. When observing staff point B from instrument station A (point B is at a higher elevation compared to A), the tilted angle of line of collimation above the horizontal is $6^0 15'$.

**1.525 (upper)** **1.175(middle)** **0.825 (lower)**

The height of the instrument at A is 1.62m. Find the horizontal distance between A and B. Further, obtained the reduced level of B if the reduced level of A is 70m. The staff was kept at the vertical position when it was taken above readings. The instrument constants are $c_1$=100 and $c_2$=0 respectively. (10 marks)

## Question 5

1. Table 4 shows offsets taken from a chain line to a irregular boundary from a chain line. Calculate the area between chain line and the boundary using **both Trapezoidal and Simpson rules**. (10 marks)

**Table 4: Offsets from chain line**

| Chainage(m) | 0 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 |
|---|---|---|---|---|---|---|---|---|---|
| Offset distance measured to the boundary (m) | 1.52 | 1.21 | 0.85 | 0.97 | 1.10 | 1.31 | 1.35 | 1.40 | 1.26 |

2. Figure 2 shows an odd shape land (ABCDEFGA) that shall be equally divided into two portions. Total area of the land is 25 perch. The division shall be done in a way, where both portions receive a road frontage. The proposed division line is XC, and angel $X\hat{G}C = 25^0$ (Road edge AG can be considered as a straight line). Area CDEFG = 129m$^2$ and length GC= 29m, calculate length XG to define subdivision line XC. (06 marks)

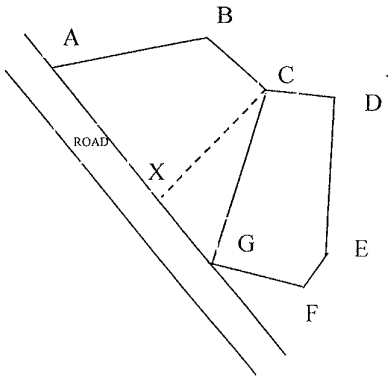


**Figure 2 :Sketch of the land ABCDEFGA**

3. Proposed another method where it can divide this land into two equal portions with road frontages for both portions. (04 marks)

## Question 6

1. Figure 3 shows a formation of a typical cutting section of a canal in an irrigation project. Derive a formula to calculate are of ABEDA in terms of h,k,n and b. (10 marks)

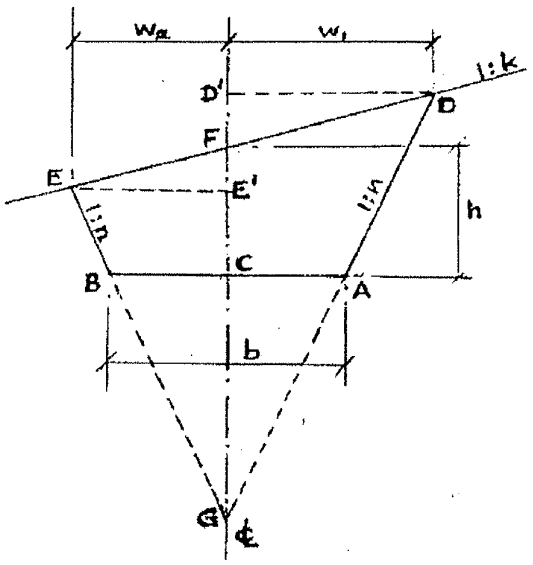


**Figure 3: Typical cutting section ABEDA**

2. Table 5 shows a calculated cutting areas along a proposed canal center line at 20m intervals.

***Table 5***

| Chainage (m) | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Area ($m^2$) | 23.5 | 21.2 | 17.2 | 15.3 | 22.1 | 23.5 | 24.6 | 25.8 | 18.7 | 19.1 | 19.3 |

Calculate total excavation volume relevant to this canal between change 0 and 200m using prismoidal and end area formulae. (10 marks)

**Question 7**

1. Main scale of a theodolite is having a division of 30' ($0.5^0$). The vernier scale in that instrument has a total of 60 divisions occupying the length of 59 divisions of main scale. The approximate reading had been read out for a measurement from this instrument is $242^0\ 30'$. The $39^{th}$ division of the vernier scale exactly coincides with a division of the main scale. What is the exact reading relevant to this measurement ? (04 marks)

2. Explain the radiation method adopted in Plane table surveying with a necessary sketch. (04marks)

3. Explain the difference between Whole circle bearing and Reduced bearing using a neat sketch. (04 marks)

4. Reduced levels of point A and B are 10.25m and 150.28m. Point B is the topmost location of a water tower. The horizonal distance between A and B is 220m. A tall boundary wall having height of 3.6m intersects with the line drawn at the horizontal plane connecting A and B at a point 21m away from A. The reduced level at intersecting point (at the bottom of the wall) is 15.5m. There is no any other obstructions affecting intervisibility of A and B. Check whether B is visible for a man standing at A having eye level at 1.2m. (08 marks)