

The Open University of Sri Lanka

Faculty of Engineering Technology



Study Programme	: Bachelor of Science in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: CVX 4342 – Surveying 1
Academic Year	: 2024/25
Date	: 24 th February 2026
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 hand/ writing.
6. Do not use Red colour pen.

Question 1

1. Point A and B are known positions of a site. There is a need to find the location of point P only using linear measurements. Propose two methods for this with clear sketches. (04 marks)
2. Explain the reasons for using two different scales for plotting longitudinal sections and cross sections of a road. (03 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 29.800m , 28.575m and 18.375m. All measurements were taken at a temperature of 20°C, and the temperature at which the tape had been standardized is 30°C. All measurements were taken under the standard pull of 15kg. Actual length of the tape was found to be 30.008m and hence, it requires to introduce standardization correction as well (Consider standard length of the tape as 30m). Following are some material properties of the tape – $E_{\text{tape}} = 17200 \text{ kg/mm}^2$, weight per unit length of the tape = 0.03kg/m, Cross sectional area of the tape = 3.05 mm^2 , $\alpha_{\text{tape}} = 13 \times 10^{-6} \text{ per } ^\circ\text{C}$. You can assume that the error for sag is given by $c = w^2 l^3 / 24 F^2$ in standard notations and given units of parameters. (08 marks)
4. Figure 1 shows a chain line having an obstruction in its path. Hence, following measurements have been taken to calculate AB. Distance DE and EC have been measured to check the accuracy of the procedure. AC = 14.255m, BC = 24.576m,

DE = 11.733 m, EC = 8.352 m

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(a) Calculate the distance AB

(b) Check whether there is any error in the procedure using the given data.
(05marks)

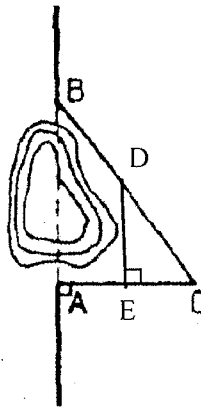


Figure 1

Question 2

- (a) Table 1 shows recorded readings of a levelling work. Calculate Reduce levels of all stations using a standard method. The Reduced level of station O is 300.000m. All error checking of the relevant method shall also be performed. (09 marks)

Table 1

Backsight	Inter sight	Foresight	Station
2.225			O
	2.005		A
	2.125		B
1.130		1.115	C
	2.120		D
	2.765		E
3.100		2.105	F
	1.895		G
		1.885	H

- (b) If station O is visible from the last instrument station (from where reading station H was taken), state the staff reading relevant to O if the line of collimation for station O and station H are same. (02 marks)
- If a staff is inclined towards instrument when taking a level reading, explain whether the error on Reduced Level of the point where staff is placed is a positive error or a negative error due to inclination of the staff. (04 marks)
- A levelling staff used for a levelling work has become 8mm shorter due to the wear and tear. Following two readings were taken using this particular staff while maintaining same line of collimation from the instrument;
Reading on a benchmark having a Reduced Level of 200.000m while holding



the staff in standard way = 2.325m

Reading on bottom of a slab while holding staff in an inverted position = 1.215 m

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Calculate the correct reduced level of the slab bottom .

(05 marks)

Question 3

- 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 WCB of all lines. The WCB (clockwise) of line AB is $121^{\circ} 05' 30''$. Error checking and distribution of errors(if any) shall be done prior to calculation of WCB. (07 marks)

Table 2

station	Line	Observed included angle			Corrected included angle			Corrected included angle (in degrees)	WCB (in degrees)
		DEG	MIN	SEC	DEG	MIN	SEC		
A		99	59	50	.....	.....	.....	.....	
	AB								.....
B		138	31	15	.....	.....	.....	.....	
	BC								.....
C		92	58	10	.....	.....	.....	.....	
	CD								.....
D		64	30	00	.....	.....	.....	.....	
	DE								.....
E		143	59	50	.....	.....	.....	.....	
	EA								.....

- Briefly describe how you minimize errors when you are taking angular measurements using a theodolite. (3 marks)
- Table 3 shows a part of table developed to calculate coordinates of a traverse survey of triangular traverse. Corrected WCB (**after making angular correction**) have been given, and you are required to calculate coordinates of the traverse point B and C. The coordinates of A can be taken as (800.00, 800.00). calculate the coordinates by completing Table 3 in your answer paper. To obtain corrected coordinates, adjustment of coordinates shall be done using an standard method. (10 marks)

Table 3

	Trave. legs	length (m)	Corrected WCB	Latitude		Departure		Corrected Latitude		Corrected Departure		Coordinates	
				North	South	East	West	North	South	East	West	N	E
A												800.00	800.00
	AB	53.015	72° 0' 45"										
B													
	BC	114.535	193° 1' 30"										
C													
	CA	98.150	345° 59' 15"										
A													



Question 4

1. Explain meaning of term "Tacheometry" in surveying and its usefulness in survey works (4 marks)
2. With the aid of Figure 2, derive the following expression for principle of a stadia tacheometer. (5 marks)

$$D = k_1 s + k_2$$

Where, k_1 and k_2 are multiplying and additive constant respectively.

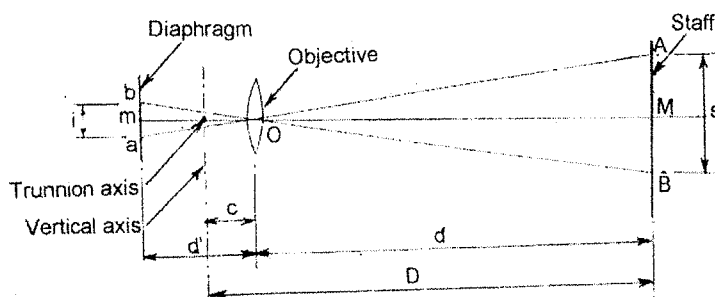


Figure 2

3. The theodolite fitted with stadia hairs, which was available for a tacheometric survey, did not have the manufacturer's values for its multiplying and additive constants. To determine these constants, a **vertical levelling staff** was observed with the telescope **set horizontal** at two known points P and Q.

The following stadia readings were recorded:

	Upper stadia reading	Lower stadia reading
At staff position P	2.430 m	2.180 m
At staff position Q	1.865 m	1.520 m

The horizontal distances to points P and Q were then measured accurately using a steel tape and were 25.400 m and 34.950 m respectively:

Determine the multiplying constant and the additive constant of the tacheometer. (6 marks)

4. Explain the engineering applications of tacheometry, with reference to contour mapping for reservoir and highway projects. (5 marks)

Question 5

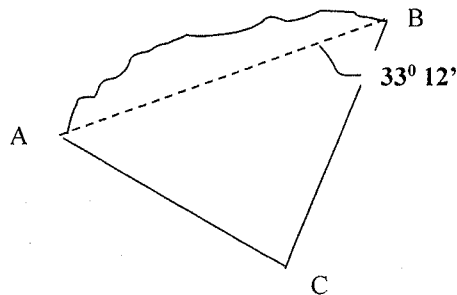
1. Figure 3.1 shows a sketch of a land. There is an irregular boundary in this land between A and B. All other boundaries are straight. Length AB (straight distance) = 12.5 m. Perpendicular offsets have been taken to the irregular boundary from line AB at a spacing of 1.25 m and tabulated in **Table 4**. Further, BC = 14.52 m and angle ABC = $33^\circ 12'$. Calculate the area of the land.

Hint : You are advised to use Simpson rule to calculate area between line AB and irregular boundary) (09 marks)

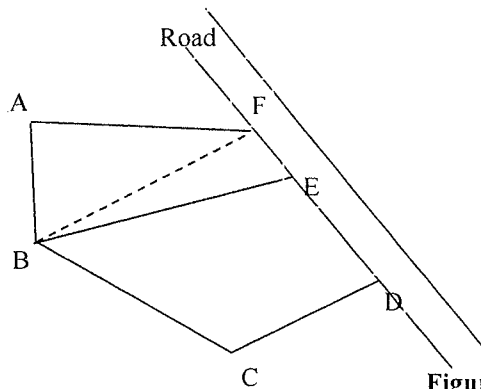
Table 4

Chainage(m)	0 (A)	1.25	2.5	3.75	5.0	6.25	7.5	8.75	10	11.25	12.5 (B)
Offset distance measured to the boundary (m)	0	1.20	0.90	0.98	1.10	1.31	1.35	1.45	1.26	0.84	0

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**Figure 3.1**

2. Land ABCDEF (given in Figure 3.2) needs to be divided into two portions. The proposed demarcation line is BE. The area required for the land portion ABEF is $\frac{1}{3}$ of the total land. The area of the land is 27 perch and the area of land portion ABF (triangular portion) is 153m^2 . Further $BF = 21.3\text{m}$ and angle $BFE = 104^\circ 30'$. Calculate the length EF where land area of ABEF becomes $\frac{1}{3}$ of the total land ABCDEF. (07 marks)

**Figure 3.2**

3. Briefly describe two methods to calculate area of plan developed for the land having irregular boundaries others than method presented in Q4(1). (04 marks)

Question 6

1. Figure 4 shows the cross section of typical road formation. The line DFE represents the existing ground level and transverse slope of that line is 1 in k. Derive a formula for the cross sectional area of formation ABEFD from parameters given in Figure 4. (10 marks)



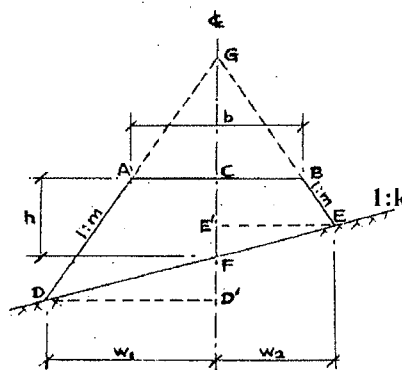


Figure 4

2. It is required to construct a volleyball court at land having varying ground profile. The approximate size required for the court is 21m x 12m. To calculate the earth volume that have to be moved to construct the court, the relevant plan area is divided to 3m x 3m grid and spot levels at each grid point were taken. The layout of Grid lines is given in Figure 5 and Reduced levels of grid points are given in Table 5. All readings are given in m. It is decided to keep the formation level of the volleyball court at 72.00 m. Calculate the soil volume that have to be cut to form this volleyball court using a standard method. (10 marks)

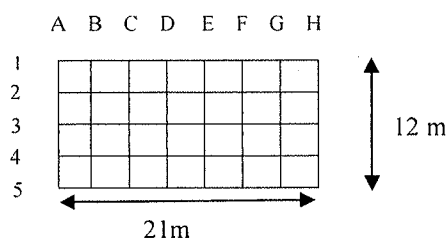


Figure 5

Table 5 : RL values of grid points

	A	B	C	D	E	F	G	H
1	73.010	72.155	72.125	72.105	72.510	73.155	73.200	72.875
2	72.910	72.250	72.550	72.000	72.280	73.000	73.255	72.975
3	72.860	72.350	72.825	72.225	72.235	72.855	73.105	73.175
4	72.755	72.255	72.235	72.230	72.240	73.105	73.155	72.555
5	73.565	72.105	72.230	72.505	72.255	73.005	73.300	72.770

Question 7

- Name three uses of contour maps in engineering applications and briefly explain one such application. (05 marks)
- Explain the Intersection (or Triangulation) method adopted in Plane table surveying with a necessary sketch. (05 marks)
- It is required to develop a contour map for a land having maximum height difference of about 4m. This contour map will be used to plan- two storey house construction of the land. What is the contour spacing that you select for this contour map? Briefly explain the reason for your selection. (05 marks)
- Level readings of two points (P and Q) along a radial line used in Spot height method for contouring have levels of 87.538m and 92.536 m respectively. Horizontal distance between P and Q is 4.58m. Calculate the distance along radial line to the intersecting point of this radial line and 90m contour line from point P. (05 marks)