Second Semester Examination
2020/2021 Academic Session

July/August 2021

EAK163 – Geomatic Engineering

Duration : 3 hours

Please ensure that this examination paper contains **TWELVE (12)** printed pages before you begin the examination.

Instructions: This paper contains **FOUR (4)** questions. Answer **ALL** questions.

All questions **MUST BE** answered on a new page.

1. (a). ‘Geomatics’ is a rapidly developing engineering discipline that focuses on spatial information to describe the cluster of technologies dealing with the location and identities of earth features. Name any **TWO (2)** sub-disciplines in geomatics technology and state their applications, respectively.

[5 marks]

(b). Measuring distances and angles from a known reference point are fundamental surveying operations. Through the use of trigonometric calculations, the distance and angle measurements are used to establish three dimensional (3-D) coordinates for each surveyed point. With the help of the sketch shown in **Figure 1**, re-sketch the set up and show the following survey measurement attributes:

- horizontal distance
- horizontal plane
- vertical angles
- vertical distances
- vertical plane

Explain the application of distance and angle measurements in civil engineering projects.

[10 marks]

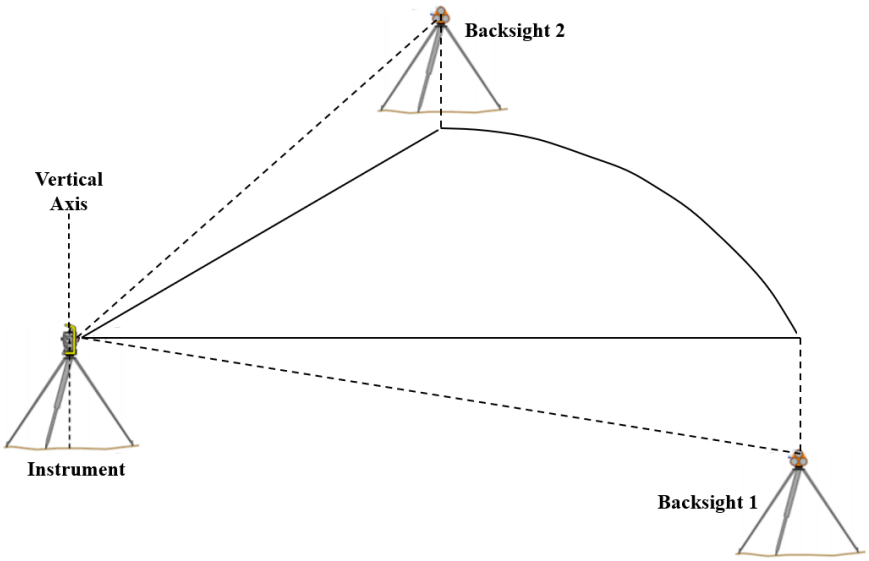

Figure 1. Survey Measurements

(c). In Geomatic Engineering, data uncertainty is due to either random error and systematic error.

i) Two groups are using the same instrument during the survey works. Their results indicate the same magnitude of errors. Identify the type of error implicated here. Justify your answer.

ii) Give **TWO (2)** examples of random errors and **TWO (2)** examples of systematic errors in geomatics measurement.

iii) Describe the solutions to solve the following;

a) incorrect instrument height,

b) incorrect target heights, and

c) imperfectly adjusted instrument.

[10 marks]

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2. (a). In a levelling work, the misclosure was determined to exceed the allowable limit for a second-class survey. It was decided that a two-peg test is required as it was suspected that the line of sight was not truly horizontal even if the bubble was in its central position.

In Stage 1, the leveling instrument was set approximately in the middle (point C), between points A and B which are 80 meters apart. From point C, the readings obtained from a staff held at point A and point B were 1.914 m and 2.237 m, respectively. The bubble was brought to the centre of its run before each reading was taken. Next, the levelling instrument was set up at position D, 5 m away from B, and the observed staff readings at A and B were 1.874 m and 2.141 m, respectively. **Figure 2** shows the plan views of the levelling instrument and staffs for the test.

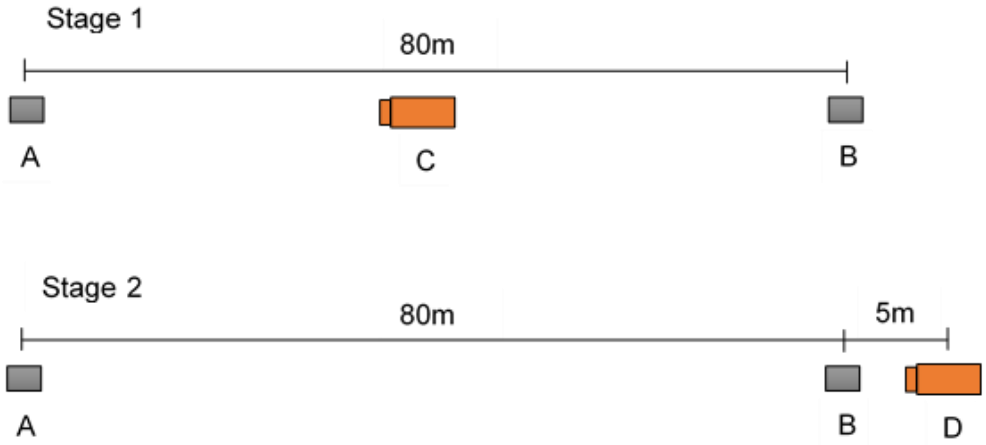

Figure 2. Plan view of the two-peg test setup

With the help of a sketch,

(i) Illustrate the line of collimation and line of sight for the two-peg test using side view of the test setup for both stages.

(ii) Assuming that the instrument is in good adjustment, calculate:

(a) the collimation error of the level,

(b) the corrected difference in Level between A and B, and

(c) the staff readings obtained from D.

[10 marks]

(b). The following closed loop levelling survey was carried out at the site from BM A311 (RL = 66.555m) to verify the reduced levels of all lamp posts (LP), covering a total distance of 1.5 km along the road and closed at BM A448 (RL = 66.682m) (**Table 1**). Use the provided **Booking Form 1** in **Appendix 1** to anwer the question. From the data,

(i). Calculate the reduced levels of all lamp posts using the Rise and Fall Method and apply all the arithmetic checks.

(ii). Determine the height of collimation during the third setup (third change point) for the levelling survey.

(iii). Based on the misclosure, determine whether the levelling survey carried out satisfy the second-class survey.

(iv). Calculate the corrected reduced levels of all lamp post points.

[15 marks]

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Table 1: Levelling Survey

Project No: USM 3/2020		Site: IPPT, USM		Job No: USM/IPPT//2020/3/HM 1(7)		
Surveyed by: Hakim A.		Date of Survey: 18 Dec 2020		Checked by: Hana M.K.		Date: 18 Dec 2020
BS	**IS**	**FS**	**Rise**	**Fall**	**RL**	**Remarks**
2.145					66.555	BM A311
1.506		2.954				LP 1
2.556		1.235				LP 2
	1.987					LP 3
	1.122					LP 4
	2.108					LP 5
3.426		2.995				LP 6
	3.181					LP 7
1.652		2.316				LP 8
	1.255					LP 9
		1.635				BM A448

*Note: LP – Lamp post. BM – Benchmark.

...7/-

3. A survey work was conducted under a scorching sunlight for a local construction project. During a short rest period, a very unfortunate event has occurred where a drinking water bottle spilled on the coordinate booking form. Luckily, some reading can be read except for data sets in the shaded cells **(Table 2 in Appendix 2)**. Calculate:

a) The bearing and distance between Station 1 to Station 2.

[5 marks]

b) The latitude, departure, corrected latitude, corrected departure, and coordinates for Stations 2, 3, 4, 5, and 6.

[15 marks]

c) The misclosure of the traverse work and state its class of survey.

[5 marks]

Note: Use any available information to calculate the missing values. All the results must be recorded in the **Form 2** provided **(Appendix 3)**.

4. (a). A plot of land ABCDA has four sides, as shown in **Figure 3**. The sides AB and BC are straight, and the sides CD and DA are irregular, and the survey data are shown in **Table 3**.

Determine the area of the plot ABCDA.

[13 marks]

Table 3. Data measured for the plot

Offsets outwards along line CD [meters]		Offsets inwards along line DA [meters]	
0	0.00	0	0.00
30	1.50	30	1.65
60	2.25	60	0.00
90	1.25	90	2.35
120	1.75	120	0.00
150	1.55	160	1.22
180	0.00	200	0.00

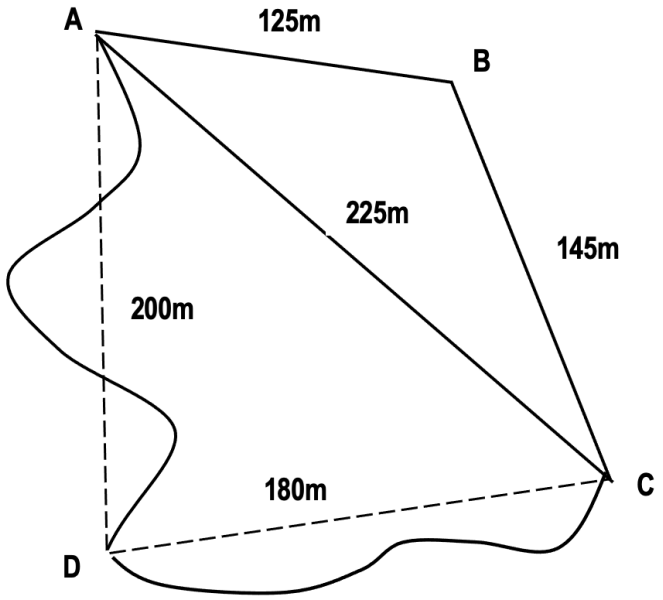

Figure 3

(b). In order to construct a shopping mall, an area of 50 m x 50 m has to be excavated at the work site. Levels (in meters) have been taken at the corners of squares of side 25 m in order to evaluate the quantity needed for excavation, and the levels are as shown in **Figure 4**. It is given that the formation level for the excavation is 115 m AMSL. The excavation is assumed to be of vertical sides.

Calculate the volume of the excavation.

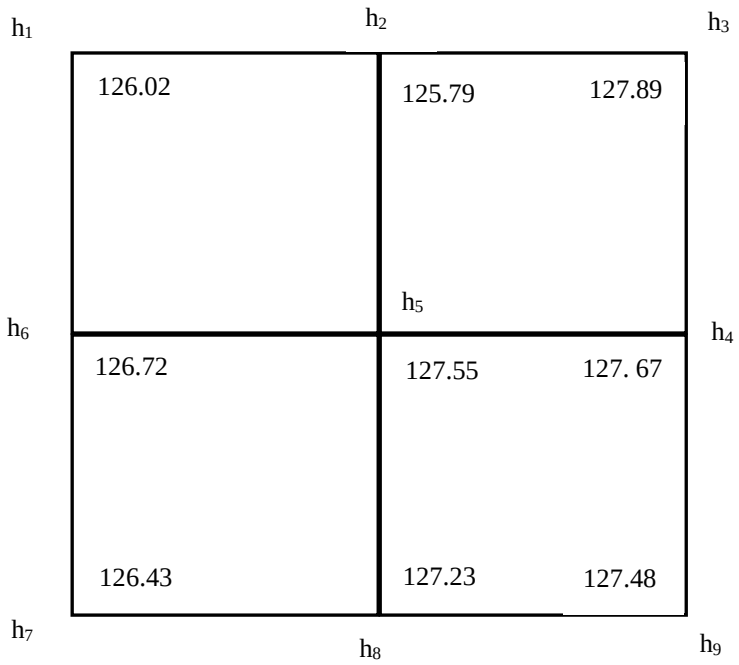

Figure 4

[6 marks]

(c). Earthworks analysis is important for engineers involved in civil engineering/land development. In order to develop any piece of property the earth will invariably need to be moved. Briefly explain **THREE (3)** different methods of determining volume of earthwork in a construction process and describe their advantages and disadvantages.

[6 marks]

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APPENDIX 1

INDEX NUMBER:_____

BOOKING FORM 1: LEVELLING							
RISE AND FALL METHOD OF REDUCTION							
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Back Sight	**Intermediate Sight**	**Fore Sight**	**Rise**	**Fall**	**Reduced Level (RL)**	**Adjusted Reduced Level (RL)**	**Remarks**
Date:							

...11/-

APPENDIX 2

Table 2. Coordinate Booking Form with Survey Data

Station	Bearing	Distance	Latitude		Departure		Adjusted Latitude		Adjusted Departure		Coordinates	
			N	S	E	W	N	S	E	W	N/S	E/W
1											10000.000	10000.000
2				35.146	34.360							
3	38°56'11"	36.874										
4	54°59'15"	28.438										
5	329°53'28"	47.133										
6	332°42'48"	46.801										
7	301°05'50"	31.871	16.461			27.291	16.462 (+0.001)			27.289 (-0.002)	10108.687	10008.450
8	231°49'58"	41.302		25.523		32.472		25.522 (-0.001)		32.469 (-0.003)	10083.165	9975.981
9	163°53'41"			83.168	24.013			83.165 (-0.003)	24.019 (+0.006)		10000.000	10000.000
		368.135										

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APPENDIX 3

Index Number: _____

TRAVERSE COMPUTATIONAL FORM 2												
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Station	Bearing	Distance	Latitude		Departure		Adjusted Latitude		Adjusted Departure		Coordinates	
			N	S	E	W	N	S	E	W	N/S	E/W
Date:												

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