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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CEX3233/CVX3533 Surveying I**
Academic Year	: 2019/2020
Date	: 31 July 2020
Time	: 0930-1230hrs
Duration	**: 3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Seven (7)** questions in **Three (3)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. If you have **attempt more than five (05)** questions (either partly or in full), cross out the extra answers. Otherwise, only the **first five answers appearing in the answer book will be evaluated.**
5. Answer for each question should commence from a new page.
6. This is Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Q1.

(a) Explain the purpose of following decisions in engineering surveying.

i). A smaller contour interval **needs to be adopted** when a relatively flat land is to be surveyed, and

ii). A smaller contour interval is **not desirable** when the plan is to be drawn to a smaller scale.

[4 Marks]

(b) In order to determine the **horizontal distance** and the **level difference** between two points **P** and **Q** in a hilly area, tachometric observations have been made to those points from two instrument stations **R** and **S** of a traverse, conducted at the foot of the hill. The details of points P and Q were sighted from station R and S respectively given in the Table Q1. The staff was **held vertically** at both points. The instrument had an analytical lens with constant 100.

Table Q1

Instrument station	R	S
Reduced level of the station (m)	64.20	62.50
Coordinates of station (m)	40.72N, 51.60E	31.24N, 90.35E
Instrument height (m)	1.52	1.45
Staff station	P	Q
Whole circle bearing	42° 30′	85° 00′
Vertical circle reading	(+) 16° 00′	(+) 12° 20′
Stadia readings (m)	0.820, 1.060, 1.300	1.600, 1.915, 2.230

i) Calculate the level difference between pints P and Q. [8 Marks]

ii) Determine the horizontal distance between P and Q. [8 Marks]

Q2.

(a) Offsets (Perpendicular distances) were taken to a boundary fence from a chain line at 15 m intervals, in a chain survey. Those measurements are 0, 4.84, 8.43, 9.76, 6.84, 2.26, and 0. Applying the **Simpson's rule**, estimate the area bounded by the fence and the chain line in units of *hectare*. All the measurements are in meters. [6 Marks]

(b) In order to construct the basement car park of a residential building, the ground was excavated down to a reduced level of 24.2 m over an area of 45 x 30 m. the existing ground has been levelled on 15 m grid, and the measured spot levels corresponding to the grid points are given below.

Table Q2

Point	R.L. (m)	Point	R.L. (m)	Point	R.L. (m)	Point	R.L. (m)
A_{11}	36.8	A_{12}	35.9	A_{13}	35.4	A_{14}	35.2
A_{21}	36.2	A_{22}	35.5	A_{23}	33.8	A_{24}	33.3
A_{31}	32.9	A_{32}	32.7	A_{33}	32.4	A_{34}	31.8

i). Indicate these grid points in a diagram, if the grid squares following diagonals on the ground surface to form triangles; $A_{21}A_{12}$, $A_{12}A_{23}$, $A_{13}A_{24}$, $A_{31}A_{22}$, $A_{32}A_{23}$, and $A_{23}A_{34}$. [2 Marks]

ii). Tabulate the required depth of excavation at each point of the grid with the number of times that the point counted for a triangle. [6 Marks]

iii). Calculate the volume of excavation to be done by considering **vertical earth prisms of triangular cross section**. [6 Marks]

Q3.

(a) Explain the reason for measuring the lengths of lines in a compass traverse using only a wire chain, while those lengths are measured with a steel band in a theodolite traverse. [5 Marks]

(b) Explain the terms "True meridian" and "Magnetic meridian" which are used as reference for bearings in compass traverse survey. [5 Marks]

(c) Explain the reason for measuring the bearings of survey lines in a compass traverse at both ends. [5 Marks]

(d) Explain the reason for taking equal number of observations on face left and face right of the theodolite when measuring horizontal angles. [5 Marks]

Q4.

(a) What is meant by the term sensitivity of a level tube? If two level tubes have their sensitivities marked as 2mm = 10" and 2mm = 30", which level tube is more sensitive? State reasons for your selection. [5 Marks]

(b) The internal angles in a traverse **ABCDEA** in the clockwise direction, measured using a theodolite were as follows;
A = 123° 00' 20", B = 105° 23' 20", C = 72° 44' 00", D = 88° 29' 00" and E = 150° 22' 20".

Adjust the angles if necessary and find the whole circle and reduced bearings of the sides of the traverse, if the **line AB** is running in the **southwest** direction. [10 Marks]

(C) Briefly explain the application of Bowditch's method to a closed traverse by adjusting latitude and departures. [5 Marks]

Q5.

(a) Define the following terms used in levelling.

(i) A Temporary Bench Mark
(ii) A Back Sight
(iii) A Fore Sight
(iv) An Inter Sight
(v) Reduced Level [10 Marks]

(b) Table Q5 shows a set of staff readings recorded by a student who has carried out levelling survey to prepare a longitudinal section for a 50 m long road section. The readings were recorded in the order of taking readings.

Table Q5

Point/ Chainage	TBM1	0.000 m	0.000 m	10.000 m	20.000 m	20.000 m
Staff Reading (m)	2.150	1.650	1.665	2.345	1.960	1.450
Point/ Chainage	30.000 m	30.000 m	40.000 m	50.000 m	50.000 m	TBM2
Staff Reading (m	2.005	2.050	2.150	2.550	2.450	2.350

(i) Book the above readings in standard record sheet used for levelling. [4 Marks]

(ii) Using **"rise and fall"** method, determine the reduced levels of each TBM and chainage points along the road section, if the reduced level of TBM 1 is 100.000 m. [4 Marks]

(iii) Determine the accurate reduced level of TBM 2, if the TBM 2 is associated with a total error of -0.035 m. [2 Marks]

Q6.

(a) Explain why accidental errors are not considered as serious as gross errors or systematic errors. [4 Marks]

(b) The length of a base was measured using a 30 m steel band, which was suspended clear of the ground in three spans. The measured lengths and the slope of the line joining the two end supports of the tape are as follows.

Table Q6

	Span 1	Span 2	Span 3
Measured length (m)	29.875	29.550	20.500
Slope	3° 30′	3° 00′	Level

The standard pull of 100 N was applied on the field for the last two spans while a greater pull of 150 N was applied for the first span in order to prevent the tape from touching some obstacles. The field temperature was 30 °C during the exercise. Estimate the true length of the base, given the following properties related to the steel band. Show your steps of calculations clearly.

Mass	=	0.0232 kg/m
Cross sectional area	=	2.35 mm^2
Young's modulus	=	20.6 x 10^4 N/mm^2
Coefficient of linear expansion	=	1.15 x 10^{-6} per °C
Standard Temperature	=	20 °C

[16 Marks]

Q7.

(a) Why is it necessary to make triangles formed by chain lines well-conditioned of which the angles are not very small or very large. [4 Marks]

(b) Explain, with the help of diagrams, how a wire chain would become (i) longer than, (ii) shorter than its nominal length. [4 Marks]

(c) Explain, with the aid of a diagram, how you would lay the chain line, when the two ends (Peg stations) are not inter-visible due to topographical features. [4 Marks]

(d) List down five (05) systematic errors that can be found in chain surveying [4 Marks]

(e) Explain the significance of Reconnaissance survey before starting chain surveying [4 Marks]