00148

THE OPEN UNIVERSITY OF SRI LANKA
HIGHER DIPLOMA IN TECHNOLOGY
CIVIL ENGINEERING – LEVEL 3
FINAL EXAMINATION - 2016/17

CEX3233 - SURVEYING I

Time allowed: Three hours

Date: Friday, 10th November 2017 **Time: 09.30 – 12.30 hours**

Answer any five questions. All questions carry equal marks.

If you have answered more than five 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.

1. **(a)** With the help of a neat sketch, state the procedure (necessary steps) for measuring an area using the planimeter with the pole placed outside the area to be measured. [4 marks]

(b) Offsets (Perpendicular distances) were taken to a boundary fence from a chain line at 15 m intervals, in a chain survey. They 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. [4 marks]

(c) In order to construct a the basement car park of a residential apartment building, the ground was excavated down to a reduced level of 24.20 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 Q1

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 in a diagram these grid points and the triangles, if the grid squares following diagonals to form triangles on ground surface; $A_{21}A_{12}$, $A_{12}A_{23}$, $A_{13}A_{24}$, $A_{31}A_{22}$, $A_{32}A_{23}$, 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. [4 Marks]

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

2. **(a)** Explain why

i). A smaller contour intervals **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 Stadia tacheometry, the graduated staff may be hold either vertically or at right to the line of sight. Compare the relative merits of above two methods of holding staff. [4 Marks]

(c) In order to determine the **horizontal distance** and the **level difference** between two points **P** and **Q** in a hilly area, tacheometric observations have been made to them from two stations **A** and **B** of a traverse conducted at the foot of the hill. The points P and Q were sighted from station A and B respectively. The staff was **held vertically** at both points. The instrument had an analytical lens with constant 100.

Table Q2

Instrument station	A	B
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) Find the level difference between pints P and Q. [6 Marks]

ii) Determine the horizontal distance between P and Q. [6 Marks]

3. **(a)** Explain why it is necessary to make the triangles formed by lines in chain survey well-conditioned (i.e. the angles are neither very large nor very small). [4 Marks]

(b) State the important conditions to be satisfied by the survey lines selected for chain survey. [4 Marks]

(c) The centre line levels of Sarasavi Garden road were checked at points A, B, C, D, E, F and G at 50 m intervals for 300 m length and following staff readings were recorded. The Bench Mark (B.M.) was 10.40 m above Mean Sea Level and all the measurements are in meters.

From instrument Position 1: 2.30 (B.M.), 1.26 (A), 1.08 (B), 0.89 (C) and 0.69 (D)
From instrument position 2: 1.64 (D), 1.43 (E), 1.22 (F) and 1.01 (G)

i) Book the above reading in standard form [4 Marks]

ii) Calculate the reduced levels of each centre point using rise and fall method and apply relevant checks. Show your calculation steps clearly. [4 Marks]

iii) Find the amount by which the road centre points are lower from a uniform gradient made by joining the start point (A) and endpoint (G). Assume that the reduced levels of A and G are fixed for the road stretch of 300 m. [4 Marks]

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

(b) Explain the terms "True meridian" and "Magnetic meridian" 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]

5. (a) State the corrections that are needed to be applied to the measured lengths using the band in catenary. [3 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 Q5

	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 indicated was 30 °C. Find the true length of the base, given the following properties related to the steel band. Show your calculation steps clearly.

Mass	=	0.0232 kg/m
Cross sectional area	=	2.35 mm^2
Young's modulus	=	206 kN/mm^2
Coefficient of linear expansion	=	1.15 x 10^{-6} per °C
Standard Temperature	=	20 °C

[17 Marks]

6. The internal angles in a closed traverse **ABCDEA** (named in an anti-clockwise direction) have been measured with a theodolite, and found to be as follows.

A = 108° 24′ 10″, B = 85° 42′ 00″, C = 121° 02′ 00″, D = 119° 19′ 30″, E = 105° 32′ 20″.

(a) Distribute any error involved with internal angles and adjust them within acceptable limits. [2 Marks]

(b) Calculate the reduced bearings of the sides of the traverse if the line **BC** runs in a **westerly direction.** [6 Marks]

(c) Prepare a traverse sheet if the corrected lengths of sides AB, BC, CD, DE and EA are 46.47 m, 54.85 m, 25.47 m, 41.10 m, and 45.30 m respectively. Assume the coordinates of point A as 100 mN, 100 mE. [8 Marks]

(d) Find the length and bearing of the line AD [4 Marks]

Note: Show your calculation steps clearly with round off values to the nearest two decimal places. You may use the attached traverse sheet.

7. (a) Explain why random errors are not considered as serious as mistakes or systematic errors [5 Marks]

(b) State the possible **sources of error** that can occur in **ordinary level surveying** and explain the reason of using reciprocal levelling. [5 Marks]

(c) Discuss the advantages and disadvantages of plane table surveying over other method of surveying. [5 Marks]

(d) Briefly explain how Bowditch's correction is applied to a closed traverse,
i) by adjusting latitudes and departures, and
ii) by adjusting the coordinates. [5 Marks]

Stn.	Line	Measured Included angle	Corr. Included angle	Whole circle bearing	Reduced bearing	Card. Pts.	Length (m)	Latitude (m)	Departure (m)	Corrected		Coordinates (m)	
										Latitude (m)	Departure (m)	NORTH	EAST