THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 3
FINAL EXAMINATION - 2013/14

CEX3233 - SURVEYING I

Time allowed: **Three hours**

Date: **Wednesday, 06th August 2014** 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.

*Note that this is a **CLOSED BOOK TEST**, and possession of texts, or any other printed or written material with you is an offence punishable under the Examination Regulations of the University.*

1. (a) A levelling survey has been undertaken to establish the reduced levels of a Temporary Bench Mark (TBM) and a bridge abutment (BA). The survey began at Bench Mark (BM) 'A' and ended at another BM 'B'. The reduced levels of 'A' and 'B' are known and are given as 67.540 m and 67.478 m respectively.

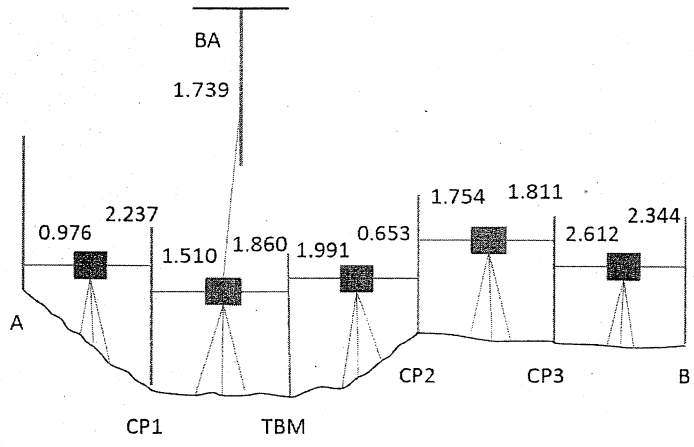

Fig. Q1

i). Using the height of collimation (HOC) method, draw a booking sheet and insert the values from Fig. Q1. **[3 Marks]**

ii). Calculate the reduced levels of all points using the HOC technique. Show examples of the calculations used in this technique. **[5 Marks]**

iii). Provide the appropriate checks. **[4 Marks]**

(b) Before a levelling survey can be carried out the instrument needs to be checked to see whether it is well calibrated. With the aid of diagrams, describe the method that is used to check a level, giving a collimation error of less than 1 mm over 50 m. **[8 Marks]**

2. (a) Describe:

i) What the aim of a traverse is, what a traverse line is and why inter-visibility is important. **[2 Marks]**

ii) What do we obtain from a traverse computation and
What are four data types that are required for a traverse computation. **[2 Marks]**

iii) Why it is important to close a closed traverse, and what is the difference between a closed and open traverse. **[2 Marks]**

iv) What are the errors mitigated when we take **Face Left** and **Face Right Horizontal Circle** Readings on a theodolite, and what is the difference between Face Left and Face Right . **[2 Marks]**

(b) A closed traverse has been carried out to connect four survey stations A, B, C and D. Part of the observed data are shown in Table Q.2a

Table Q2a

At	To	Mean Angle
A	D	
A	B	90° 00′ 10″
B	A	
B	C	90° 00′ 06″

Assuming the bearing from D to A to be 90° 00′ 00″, produce a sketch of the partial traverse and then carry out a traverse calculation to estimate the Whole Circle Bearings from survey stations A to B and from survey stations B to C. (NOTE: Full marks will only be awarded for answers that show how each value obtained at each stage was calculated.) **[6 Marks]**

(c) The remainder of the observed data for the loop traverse in part (b) are shown in Table Q.2b.

Table Q2b

At	To	Mean Angle
C	B	
C	D	90° 00′ 00″
D	C	
D	A	90° 59′ 50″

Calculate the angular misclosure for the closed traverse and assess whether this misclosure was within specification if the allowed misclosure was 10″ for the above closed travers. (NOTE: Full marks will only be awarded for answers that show how each value obtained at each stage was calculated.) **[6 Marks]**

3. (a) What do you understand by the sensitivity of the level tube? Two level tubes have their sensitivities marked as 2mm= 10″ and 2mm=30″ which one is more sensitive? Give reasons for your selection? **[4 Marks]**

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

(c) Why is it necessary to make triangles formed by chain lines well-conditioned that is the angles are not very small or very large? **[4 Marks]**

(d) Why is it necessary to measure the bearing of survey lines in a compass traverse the both ends? **[4 Marks]**

(e) Explain how you carry out the corrections for the sagging and temperature with the necessary formulae in band taping. **[4 Marks]**

4. (a) Considering a theodolite, state what is the trunnion axis error and then briefly describe the procedure to eliminate above error. **[2 Marks]**

(b) A closed traverse has been carried out to connect three survey stations. The observed data are shown in Table Q4. The bearing from C to A is 0° 00′ 00″ and positional coordinates of A is 100.000 mNorth, 50.000 mEast. Produce a sketch of the traverse and then carry out a traverse calculation to estimate the angular and positional misclosures. (NOTE: Marks will only be awarded for answers that use a traverse calculation. No marks will be awarded for answers which attempt to 'solve the triangle' by some other means. Furthermore, full marks will only be awarded for answers that show how each value obtained at each stage was calculated).

Table Q4

At	To	Mean Angle	Plan Distance
A	C		
A	B	90° 00′ 10″	100.009m
B	A		
B	C	45° 00′ 06″	141.429m
C	B		
C	A	44° 59′ 50″	99.995m

[8 Marks]

(c) The specifications for the closed traverse in part (b) were 5″ for angular misclosure and 1:5,000 for positional misclosure. Comment on whether the traverse was within specification. **[8 Marks]**

(d) If a specific angle in the traverse had not been measured, state what the surveyor should do and state what the surveyor should not do, and give logical reasons? **[2 Marks]**

5. **(a)** Briefly explain the ways in which the volume of earthwork may be calculated (you may include two methods) **[4 Marks]**

(b) The existing ground was levelled on a 10m grid and the spot levels in meters are given on Table Q5. Excavation was done for the basement of a building down to a reduced level of 30 m over an area of 40 m x 30 m.

Table Q5

46.2	47.3	48.0	49.6	49.4
46.4	44.5	44.0	46.2	44.0
42.1	42.8	45.4	46.5	49.3
36.6	35.0	36.2	35.8	37.6

It has been observed that the diagonal marked with broken lines in the Fig. Q5 make top surface of the plane. Calculate the volume of excavation considering the vertical earth prism of triangular cross sections. **[16 Marks]**

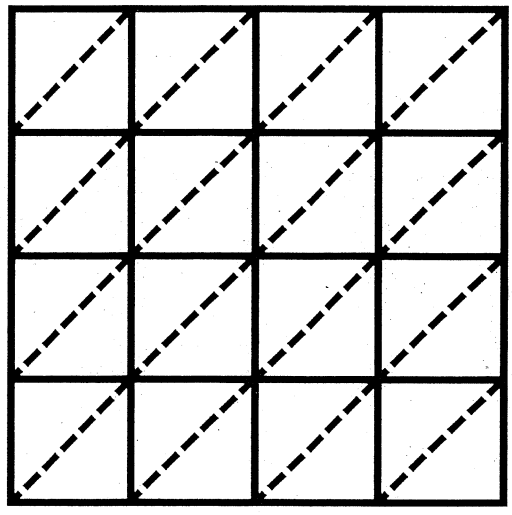

Fig. Q5

6. **(a)** An instrument manufacturer has asked you to help with the design of some new Theodolite instruments. Mention the two instrument parameters that you would need if you want use this instrument for tachometry surveying. Describe the process of how you evaluate them in the field. **[5 Marks]**

(b) There is a great concern that a proposed new underground tunnel will cause movement to an historic building which is located above the route. Of particular concern on the historic building are some tall towers which require monitoring in three dimensions to a precision of ±0.5mm. Discuss how you would advise the survey to be undertaken. **[5 Marks]**

(c) It was required to determine the distance between two points A and B by a tachometry method. You can assume the instrument constants are K=100 and C=0. Keeping the instrument at A and staff at B, the observations were made as vertical angle 9°46′ and staff intercept upper 2.915 and lower 0.234 (Staff was held vertically).

What is the horizontal distance AB. However later it was found that the constants are as 98 and 0.5 (K and C respectively). What is the percentage change in the calculated horizontal distance? **[10 Marks]**

7. **(a)** What are the possible errors that can occur during the level surveying (mention four errors applicable only to level surveying). **[4 Marks]**

(b) A levelling run has been carried out in order to measure and calculate the reduced level of a TBM and an elevated post. Table Q7 illustrates the booking sheet used for this purpose.

(i) Calculate the reduced levels for all the stations, using the rise and fall method. **[6 Marks]**

(ii) Show the checks you would carry out on the calculations. **[5 Marks]**

(iii) The reduced level of BM2 is 98.395 m, using this reading calculate the misclosure of the levelling run, and distribute it. **[3 Marks]**

(iv) What do the abbreviations in the booking sheet mean? **[2 Marks]**

Table Q7

BS	IS	FS	Rise	Fall	RL	Remarks
1.426					100	BM1
1.368		1.892				CP1
1.287		1.743				TBM
	1.926					Elevated post
1.102		1.689				CP3
		1.514				BM2