THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY – LEVEL 3
FINAL EXAMINATION – 2009/10

CEX3233 – SURVEYING I

Time allowed: Three hours

Date: Wednesday, 03rd March 2010 Time: 0930 – 1230 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) In your opinion, which of the following types of error is most serious, and which one is the least serious; (i) systematic error, (ii) random error, and (iii) gross error? Give reasons in support of your answer.

(b) The length of a base line was measured using a steel band of nominal length 30 m, which was suspended clear of the ground, in three spans. The measured lengths and the slope between the two end supports are given in the following table.

	Span 1	Span 2	Span 3
Measured length (m)	29.777	29.840	21.919
Slope	+ 5° 30'	- 2° 00'	Level

A pull of 12 kg was applied through a spring balance for the first two spans while a higher pull of 15 kg was required for the last span in order to avoid the band touching some bushes below. The atmospheric temperature was 30 °C.

The steel band has been standardised at a temperature of 20 °C under a pull of 100 N and found to be 30.003 m long. Find the true length of the base using the following physical properties relating to the steel band.

Mass	= 0.0233 kg/m
Area of cross section	= 2.35 mm^2
Modulus of elasticity	= 206 kN/mm^2
Coefficient of linear expansion	= 1.15 x 10^{-5} per °C

2. (a) The telescope in a theodolite may be turned about its vertical axis either with the lower clamp fixed and the upper clamp slack, or with the upper clamp fixed and the lower clamp slack. Explain what physically happens in each situation, and what you will be able to observe.

(b) Explain why you make an equal number of rounds of observations on face left and face right when measuring a horizontal angle using a theodolite. Is it necessary that you always swing the telescope in the clockwise direction while making observations on face right, and in the anticlockwise direction when on face left? Give reasons.

3. The internal angles in a traverse ABCDEA (named in an anticlockwise 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", and E = 105° 32' 20".

   Find the reduced bearings of the sides of the traverse if the line BC runs in a westerly direction. If the lengths of sides AB, BC, CD, DE and EA are 46.47, 54.85, 25.47, 41.10 and 45.30 m respectively, find the lengths and bearings of AD and BE.

4. (a) What do you understand by 'local attraction' in compass surveying?

   The compass bearings measured at the two ends of each line in a traverse ABCDA are given in the table below.

Line	Fore bearing	Back bearing
AB	89° 15'	271° 00'
BC	121° 15'	300° 00'
CD	240° 30'	60° 30'
DA	315° 15'	134° 45'

   Locate the positions where local attraction was present, and find the true bearings of sides.

   (b) Explain why, (i) a smaller contour interval needs to be adopted when a relatively flat land is surveyed, and (ii) a smaller contour interval is not desirable when the plan is to be drawn to a smaller scale.

   Briefly describe the uses of contour plans, giving suitable diagrams where necessary.

5. A 300 m length of a road proposed to be improved has been levelled along its centre line and reduced levels computed by the height of collimation method. A cup of tea has been accidentally spilled on the field book thereby making some of the entries illegible. The table below is an extract of the relevant page of the field book in which the entries that could not be read are marked as 'xxx'. Insert the missing entries in the table.

Back sight	Inter sight	Fore sight	Height of collimation	Reduced level	Distance	Remarks
1.43			xxx	xxx		Bench mark
	2.18			xxx	0	
	1.74			xxx	30	
3.08		0.65	xxx	68.03	60	
	2.16			68.95	90	
	1.29			xxx	120	
2.92		0.61	xxx	xxx	150	
	1.84			xxx	180	
3.12		xxx	xxx	72.80	210	
	2.18			73.74	240	
2.76		xxx	xxx	74.72	270	
		xxx		76.23	300	

   The proposed improvement involves re-grading the road to a 3 % gradient, rising from 0 to 300 m and passing through the existing surface at chainage 150 m. Find the depth of excavation / height of fill required at each point.

6. In stadia tacheometry, the graduated staff may be held either vertically or at right angles to the line of sight. Compare the advantages and disadvantages of the two methods.

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 stations A and B respectively. The staff was held vertically at both points. The instrument had an anallactic lens with a constant of 100.

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

Find the horizontal distance PQ, and the level difference between P and Q.

7. A traverse ABCDA runs along the straight boundaries of a plot of land. The latitudes and departures of its sides have been computed from the adjusted angles and lengths of sides, and are given in the table below. Find the area of the plot of land in hectares.

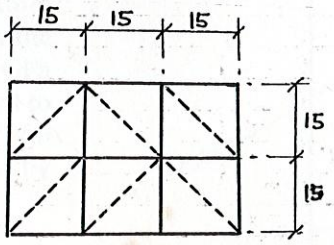
Line	Latitude, m	Departure, m
AB	(+) 41.55	(-) 19.40
BC	(-) 38.25	(-) 81.09
CD	(-) 41.78	(+) 58.58
DA	(+) 38.48	(+) 41.91

The land borders a road along the boundary BC. It is required to partition this land into two parts of equal extent using a straight line boundary. The plot to the north, which is intended to be used for a commercial purpose, requires a road frontage of 60 m. Show how you partition the land.

8. List the different methods by which earthwork could be computed, and indicate one example for each method.

The ground was excavated down to a reduced level of 24.20 m over an area of 45 x 30 m in order to construct the basement of a building. The existing ground had been levelled on a 15 m grid, and the spot levels (in metres) corresponding to the grid points are given below.

36.8	35.9	35.4	35.2
36.2	35.5	33.8	33.3
32.9	32.7	32.4	31.8



It has been observed that the diagonals marked with broken lines on the figure above make the top surface of each of the resulting triangular prisms into a near plane surface. Find the volume of excavation considering vertical earth prisms of triangular cross section.