THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY (ENGINEERING) - LEVEL 5
FINAL EXAMINATION - 2013/14

CEX5230 - SURVEYING II

Time allowed: **Three (03) hours**

Date: **2014 – 09 – 05 (Friday)** Time: **09.30 – 12.30 hrs**

Answer any Five (05) Questions. All Questions carry equal marks.
If you have answered more than five questions (either in part or in full), cross out the extra answers. Otherwise, only the first five answers appearing in the answer book will be evaluated.

Q1.

(a) Explain the importance of drawing the mass-haul diagram in Highway Engineering.

(b) The table below gives the volumes of excavation (+) and fill (-) contained between successive cross sections along a 2.0km length of a road taken at 100m intervals.

Table 1

Chainage (m)		Volume (m^3)	Chainage (m)		Volume (m^3)
From	To		From	To	
0	100	600	1000	1100	-355
100	200	725	1100	1200	-625
200	300	850	1200	1300	-825
300	400	995	1300	1400	-965
400	500	1400	1400	1500	-720
500	600	1250	1500	1600	-550
600	700	975	1600	1700	-325
700	800	625	1700	1800	-100
800	900	225	1800	1900	255
900	1000	-25	1900	2000	425

Draw the mass-haul diagram for the project if the material encountered from the beginning to the chainage 900 m has a swelling factor of 1.1.

If you are given the choice of wasting excess material at one of the two ends, which alternative would you recommend in order to minimize the haul, giving logical reasons. Also calculate the over-haul for the selected alternative if the free haul distance is specified as 400m.

Q2.

(a) Describe briefly simple curves, compound curves and reverse curves using neat sketches.

(b) Explain the procedure that has to be followed in setting out circular curves using a theodolite and a steel tape.

(c) A circular curve of radius 550m connects two straights having a deflection angle of 20^o 42' and chainage at the intersection point is 1465.00m. Tabulate the data needed to set out this curve by theodolite and steel tape.

Q3.

(a) List factors that are affecting the length of a vertical curve.

(b) Explain the procedure for setting out of a vertical curve.

(c) A rising gradient of 4% joins a 3% falling gradient in a vertical curve of a road section. A vertical parabolic curve 250m long is to be introduced between the two grades. Calculate the complete data set required to set out the curve. You can take the reduced level of intersection as 500m and the chainage as 2500m. Also consider peg intervals as 20m.

Q4.

(a) Define the following terms:

(i) A conditioned quantity
(ii) The residual of an observed quantity
(iii) The most probable value of an observed quantity

(b) The following set of reduced equations was obtained for a group of indirectly observed independent angles.

$r_1 = 0$ (weight 1)
$r_2 = 0$ (weight 1)
$r_3 = 0$ (weight 1)
$r_1 + r_2 - 1.0 = 0$ (weight 2)
$r_2 + r_3 + 1.5 = 0$ (weight 2)
$r_1 + r_2 + r_3 + 0.5 = 0$ (weight 3)

(i) Write down normal equations for r_1, r_2 and r_3.
(ii) Solve for r_1, r_2 and r_3.
(iii) If the measured value of the angle A (corresponding to r_1) is $35^0\ 12'\ 30''$, determine its corrected value.

Q5.

(a) Explain how you would carry out an aerial photogrammetric survey in a selected area using neat sketches.

(b) Derive a mathematical expression for the **image displacement due to ground relief**. You can assume that the photograph is vertical and flying height of the aircraft is "**H**" above the datum. "**h**" is the height of the top or high point above the datum and "**r**" is the photo radial distance from plumb point to the image of the top or high point.

(c) In an aerial photograph, it was found that the radial distance to the image of the base of a telecommunication tower is 82.45mm, and the radial distance to the image of its top is 84.65 mm. If the flying height of the plane is 6000m above mean sea level, and the elevation of the tower base is 450m, determine the height of the tower.

Q6.

(a) List the different conditions prevailing in a tunnel survey as compared to a surface survey.

(b) Explain the modifications that you adopt to avoid above mentioned difficulties.

(c) In a tunnel survey, stations, **A**, **B** and **C** are back station, instrument station and forward station respectively marked on the roof of a tunnel. The coordinates of A and B are as follows. (E stands for east, and N stands for north).

$E_A = 545.225m$ $N_A = 1463.450m$
$E_B = 604.845m$ $N_B = 1447.660m$

The reduced level of B is 212.560m above mean sea level (MSL). The theodolite observations made from the instrument station B are as follows.

Table 2

Face Left	Angles	Target at A	Target at C
	Horizontal	00° 02'00"	153° 23' 40"
	Vertical		10° 36' 10"
Face Right	Angles	Target at A	Target at C
	Horizontal	180° 02'00"	333° 23' 50"
	Vertical		10° 35' 40"

The height of station B above the transit axis is 1.565m. The height of station C above the target at C is 0.815m. The slope distance from the transit axis to the target at C is 44.225m. Find the coordinates and the elevation of the station C.

Q7.

(a) Explain different types of networks used in triangulation survey.

(b) Explain different types of corrections that are generally required for a base line measurement of band taping.

(c) Stations A, B, C, D, E and O are triangulation stations formed by a polygon with a central hub at O. The adjusted angles of the triangulation are given in Table 3. The base line AB was measured to be 12675.356m long. The coordinates of A are 163596.39m East, and 95237.54m North. The bearing of AB is 56° 45' 45", determine the coordinates of the triangulation stations.

Table 3

Angle	Adjusted value	Angle	Adjusted value
1	52° 34' 24"	9	51° 38' 22"
2	47° 27' 39"	10	52° 32' 12"
3	58° 38' 04"	11	79° 57' 57"
4	54° 56' 37"	12	66° 25' 19"
5	47° 22' 33"	13	83° 25' 13"
6	49° 12' 14"	14	85° 53' 46"
7	47° 33' 45"	15	75° 49' 26"
8	46° 32' 29"