THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY (ENGINEERING) - LEVEL 5
FINAL EXAMINATION - 2014/2015

CEX5230 - SURVEYING II

Time allowed: Three hours

Date: Friday, 18th September 2015 Time: 0930 – 1230 hrs.

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

Q1.

(a) It is necessary to provide a reverse curve on railway lines due to the topography variations. Show on a clear diagram how such a curve is introduced, indicating its different components. Give reasons as to why such components are necessary. (6 marks)

(b) Illustrate using an appropriate figure, how to set out a small horizontal circular curve from its long chord by chaining and offsetting. (4 marks)

(c) Two straights having whole circle bearings of 81^0 30' and 154^0 10' are joined by a circular curve together with cubic parabolic transitions at either end. The design is made for a speed of 100 km/h in such a way that the centrifugal ratio does not exceed 0.25, and the rate of change of radial acceleration does not exceed 0.3 m/s^3. If the chainage of the intersection point is 620.8 m from the preceding kilometre post, find the chainages of the tangent points and of the two ends of the circular arc.

(10 marks)

Q2.

(a) Explain why the daytime visibility factor is important in designing a crest and sag vertical curve. (4 marks)

(b) A road has an ascending gradient of 4.5 per cent joined to a descending gradient of 2.5 per cent by a parabolic vertical curve of length 100 m. Find the visibility distance measured between two points at 1.05 m above the road surface on the approaching vehicles.

(4 marks)

As part of a road improvement scheme, it is proposed to replace the existing curve by a new parabolic curve in order to increase the visibility distance to 150 m. Find,

i. The length of the new curve
ii. The horizontal distance between the old and new tangent points on the 4.5 per cent grade.
iii. The horizontal distance between the summits of the old and new curves.

The following relationships (with the usual notation) between visibility and the length of curve may be used.

(12 marks)

$L = S^2A / 200(\sqrt{h_1} + \sqrt{h_2})^2$ for $S \leq L$ and $L = 2S - 200(\sqrt{h_1} + \sqrt{h_2})^2 / A$ for $S \geq L$

Q3.

(a) Elaborate the different conditions that you would face in a tunnel survey in comparison to a surface survey. (4 marks)

(b) The lighting inside a tunnel is usually poor. Briefly explain with necessary diagrams, how you would overcome this shortcoming when making observations with a theodolite inside a tunnel. (6 marks)

(c) The following is the record of a theodolite traverse and it is necessary to connect the point A and point F through a tunnel. Find the length, bearing and the gradient of the tunnel to be excavated, if A is 550 m above F. (10 marks)

Line	Length (m)	Bearing
AB	1855	N 35^0 30' E
BC	1388	S 70^0 30' E
CD	1770	N 75^0 30' E
DE	2055	S 25^0 30' E
EF	2235	S 70^0 30' W

Q4.

(a) Explain the different types of errors that may occur in measurements and the use of 'principle of least squares' in minimizing the accidental errors. (6 marks)

(b) Levelling was carried out between each pair of stations in the network ABCD, and the results obtained are given below, along with the relative weight assigned to each measurement.

From station	To station	Level Diff. (m)	Weight
A	B	4.68	2
A	C	7.52	2
A	D	3.65	2
B	C	2.82	1
B	D	-1.00	1
C	D	-3.83	2

If the reduced level of the station A is 624.320 m, find the most probable values of the reduced levels at stations B, C and D. (14 marks)

Q5.

(a) A phototheodolite was set up at a station P to take a photograph of points A and B, which are to be observed. On a photograph taken at station P, the point A was found to be 30.50 mm to the left of the vertical hair and 12.00 mm above the horizontal hair, while point B was found to be 38.50 mm to the right of the vertical hair and 19.00 mm below the horizontal hair. The horizontal angle measured at station P, between two points A and B was 25^0 52' 30" and the horizontal distance to point A from station P is found to be 89.00 m.

i. Determine the focal length of the camera
ii. Find the horizontal distance to point B from station P, if the height difference of points A and B is 15.65 m.
iii. Find the reduced levels of point B and point A, if the reduced level of the camera axis at station P is 68.86 m above MSL.

(12 marks)

(b) Derive a mathematical relationship to show the displacement of image in an aerial photograph due to ground relief.
An aerial photograph was taken of a flat urban area from an aircraft flying at a height of 5350 m above MSL. The radial distance to the image of the base of a transmission tower is 85.20 mm, and the radial distance to the image of its top is 86.85 mm. Determine the height of the tower, if the elevation of the tower base is 50 m. (8 marks)

Q6.

(a) What is a mass-haul diagram? Briefly explain the importance of the mass-haul diagram in earthwork involved during road or railway constructions. (8 marks)

(b) Table below refers to earthwork for a proposed rural road project, which is to be balanced on a 1200 m long stretch. The levels given are for the existing ground, and the volumes are the excavations (+) and fill (-) involved in making a formation that is rising at the rate of 1.2 per cent, from a level of 20.0 m at the chainage of 1500 m.

Chainage(m)	1500		1600		1700		1800		1900		2000		2100
Ground Level on Centre line (m)	29.1		33.7		30.0		24.6		22.1		19.0		16.5
Volume (m^3)		(+) 2350		(+) 1972		(+) 698		(-) 324		(-) 1631		(-) 2555	
Chainage(m)		2200		2300		2400		2500		2600		2700	
Ground Level on Centre line (m)		19.4		26.0		30.8		37.5		38.8		41.5	
Volume (m^3)	(-) 2660		(-) 1397		(-) 367		(+) 654		(+) 1290		(+) 912		

i. Draw the longitudinal section of the existing ground and mark the new formation
ii. Draw the mass-haul diagram for the proposed road, using a bulking factor of 1.2
iii. Calculate the total haul in this 1200 m length and the over-haul if the free haul distance is specified as 400 m. You may assume the datum line as the balancing line.
iv. Find the total free haul volume and total over haul volume of the road project.
(12 marks)

Q7.

(a) Briefly explain the ideal requirements for the selection of stations in a triangulation survey and the commonly used geometrical conditions to adjust such networks. (6 marks)

(b) Figure Q7 shows a triangular network in which the angles marked 1-14 have been measured with the same degree of precision. The length AB has also been measured. Describe the steps that you would follow in order to obtain the most probable values of the angles in the network. Write down all the condition equations. (8 marks)

(c) Describe in steps how would you proceed to compute the coordinates of the other stations of the network, if the coordinates of point A and the bearing of line AB are known. (6 marks)

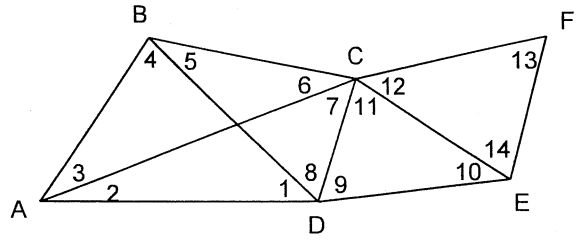

Figure Q7