00133

THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY (ENGINEERING) - LEVEL 5
FINAL EXAMINATION - 2010/11

CEX5230 - SURVEYING II

Time allowed: Three hours

Date: Thursday, 31st March 2011 Time: 1400 - 1700 hours

Answer any five questions. All questions carry equal marks. Graph paper will be provided.

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. Briefly explain why transition curves are used in road design, and what factors influence the selection of the length of such a curve.

   Two straights on an existing road are connected by a compound circular curve consisting of two arcs AB and BC of radii 630 m and 840 m respectively. The long chords of the two arcs are 360.15 m and 418.27 m respectively. It is proposed to improve the road by joining the two straights using a single circular arc with transition curves of 120 m length at each end, keeping the starting point of the curve (A) unchanged. Find the radius of curvature and the length of this circular arc.

   Also, locate the new tangent point on the second straight.

2. Two grades AI and BI are to be joined at its summit by a parabolic vertical curve. The point A, lying on the gradient that rises at the rate of 1 in 60, has a reduced level of 65.12 m and a chainage of 2080.00 m. The point B lies on the gradient that falls at the rate of 1 in 50, at a chainage of 2392.00 m, and has a reduced level of 63.72 m. It is stipulated that the curve must pass through a point P, having a reduced level of 66.55 m and a chainage of 2204.00 m. Find the length of the curve, and the visibility distance measured between two points 1.05 m above road surface.

   The following formulae for sight distance, with the usual notation, may be used.
   $L = S^2A / 200 (\sqrt{h_1} + \sqrt{h_2})^2$, for $S \leq L$, and
   $L = 2S - 200 (\sqrt{h_1} + \sqrt{h_2})^2 / A$, for $S \geq L$

3. (a) Underground surveys are conducted in poor lighting conditions. Briefly explain how you would overcome this shortcoming when making observations with a theodolite inside a tunnel.

   (b) Derive a mathematical expression for the correction to be applied to a vertical angle measured using a theodolite with a top-mounted auxiliary telescope.

   (c) List the survey operations to be made to transfer surface bearings through a single vertical shaft during the construction of a tunnel.

4. What is the difference between *true error* and *residual error*? Explain the need to find a *most probable value* for an observed quantity.

The following level differences were obtained by running a series of level networks.

From stn.	To stn.	Level diff. (m)	Weight
A	B	21.152	1
B	C	15.030	2
C	D	17.380	3
A	D	53.545	1

Calculate the most probable values of the level differences between A and C, and between B and D.

What would have these level differences been if all measurements had equal weights?

5. Fig. 1 shows a triangulation network in which angles marked 1 - 25 have all been measured to the same degree of precision. The coordinates of the station A are known, and the length and bearing of the line AB were measured. Indicate the steps involved in adjusting the angles in the network.

State the different triangulation figures that make up the given network, and write down all the condition equations.

How do you compute the coordinates of the remaining stations in the network?

6. Explain the terms *free haul volume*, *over haul volume*, *free haul* and *over haul* in earth moving.

The table below gives the volumes of excavation (+) and fill (-) contained between successive cross sections along a 1.6 km length of a proposed road, taken at 100 m intervals.

Chainage (m)		Volume (m^3)	Chainage (m)		Volume (m^3)
From	To		From	To	
0	100	565	800	900	- 1300
100	200	720	900	1000	- 1760
200	300	735	1000	1100	- 365
300	400	510	1100	1200	- 85
400	500	155	1200	1300	215
500	600	- 340	1300	1400	1110
600	700	- 710	1400	1500	1505
700	800	- 1130	1500	1600	1225

Draw the mass haul diagram for the project if the material encountered in the first kilometre has a shrinkage factor of 0.92, and the material in the remaining length has a factor of 1.00.

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

7. Two objects A and B were photographed from two camera stations P and Q using a photo theodolite with a focal length of 300 mm. The station Q was situated 1440 m to the east of station P. The photo coordinates measured on the two prints are given in the table below. The horizontal camera axis was pointing in the directions N 32° 30' E and N 36° 00' W respectively at P and Q.

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Object	Photograph at P		Photograph at Q	
	x (mm)	y (mm)	x (mm)	y (mm)
A	(-) 37.0	(+) 12.0	(-) 45.5	—
B	(+) 33.5	(-) 18.5	(-) 25.0	—

Find the coordinates of A and B and their elevations with respect to station P if the height of camera axis at P was 1.52 m.

If the station Q was 3.45 m higher than the station P, and the height of camera axis at Q was 1.40 m, what would be the y- photo coordinates of A and B on the photograph taken at Q?

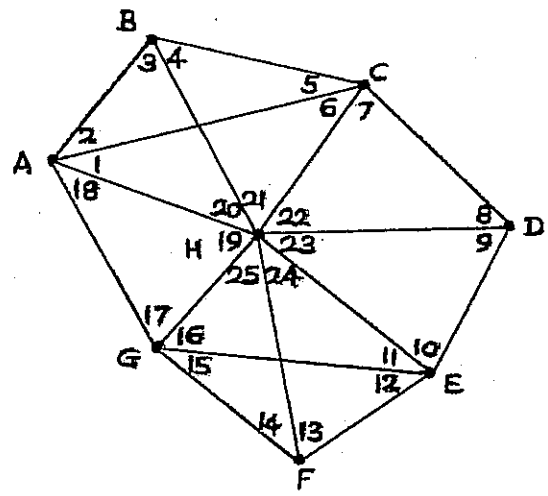

Fig. 1