THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY (ENGINEERING) – LEVEL 5
FINAL EXAMINATION – 2008/09

072

CEX 5230 – SURVEYING II

Time allowed: Three hours

Date: Wednesday, 08th April 2009 Time: 0930 – 1230 hours

Answer <u>any five</u> questions. All questions carry equal marks.

If you have attempted more than five questions, whether in part or in full, cross out the extra answers. Otherwise, only the first five answers appearing in the answer book will be evaluated.

1. What do you understand by a *wholly transitional curve*?

   Two straights with whole circle bearings of 65° 50' and 81°20' are connected by means of a wholly transitional curve. The road is designed for a vehicle speed of 90 km/h, and the rate of change of radial acceleration is limited to 0.3 m/s^3. Find the minimum radius of the curve, and the total length of the curve.

   If the coordinates of the intersection point are 1648.2 m north and 2233.6 m east, determine the coordinates of the two tangent points.

   The length of a transition curve, L, may be expressed as, $L = V^3 / 46.66\ cR$, with the usual notations.

2. A level stretch of road at an elevation of 64.50 m above mean sea level is followed by a descending grade of 4.0 %. They are to be connected by a parabolic vertical curve of length 180 m. The intersection point has a chainage of 2130.0 m. Find the levels along the curve at 15.0 m intervals in order to set it out.

   Find the chainages of points at which the gradient is 1.0, 2.0 and 3.0 percent respectively.

   If an object of height 60 mm lies on the road 10 m before the lower end of the curve, and a vehicle approaches along the flat grade, find the position from where the driver will begin to see the object. Assume the driver's eye level to be 1.05 m above the 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) Briefly explain the special requirements in the instruments used for, and the procedures adopted in, underground surveys as compared to surface surveys.

   (b) Derive expressions for any corrections to be applied to horizontal angles measured using a theodolite fitted with, (i) a side mounted auxiliary telescope, and (ii) a top mounted auxiliary telescope.

4. (a) Briefly explain the difference between *true error* and *residual error*, and the need to find a *most probable value* for a quantity.

(b) In a network of levels consisting of five stations A, B, C, D and E, levelling has been conducted between pairs of stations as shown in Table 1, the last column indicating the relative weight assigned.

Table 1

From Stn.	To Stn.	Level Difference, m	Weight
A	B	+ 3.340	2
B	C	+ 6.050	2
C	D	– 1.650	2
D	E	– 5.670	2
E	A	– 2.060	2
B	E	– 1.280	1
C	E	– 7.350	1

If the reduced level of the station A is 21.020 m above mean sea level, find the most probable values of the reduced levels of the other four stations.

5. Explain the meanings of *free haul distance*, *free haul volume* and *free haul*, and mark them on a sketch of a mass haul diagram.

Table 2 shows the earthwork involved in each 100 metre length of a 1.2 km long road to be developed.

Table 2

Chainage, m	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	500 - 600
Cut volume, m^3	2686	2202	790	83	----	----
Fill volume, m^3	----	----	----	430	1497	2807
Chainage, m	600 - 700	700 - 800	800 - 900	900 - 1000	1000 - 1100	1100 - 1200
Cut volume, m^3	----	----	----	523	1045	621
Fill volume, m^3	2925	1552	328	----	----	----

Construct the mass haul diagram for this project, assuming a bulking factor of 1.2. Also, calculate the free haul and the over haul within this 1200 m length if it is specified that the haul distance should not exceed 550 m. The free haul distance is specified as 350 m.

6. Explain the purpose of a triangulation survey. Describe the steps involved in conducting a triangulation survey, from the selection of stations and the base line to the final adjustment of angles in the network.

If the coordinates of one station and the bearing of one line at this station are known, how would you proceed to compute the coordinates of the rest of the triangulation stations?

7. The horizontal angle between two points A and B was measured at a station P, and was found to be 23° 43'. On a photograph taken at P, with the camera axis set horizontally, the image of A was found to be 33.0 mm to the left of the principal line and 18.6 mm above the horizon line, while the image of B was 30.0 mm to the right of the principal line and 15.2 mm below the horizon line. Find the focal length of the camera lens.

   It was later discovered that the camera axis was actually tilted upwards by 3° 00'. The camera height was 1.50 m above ground. If the horizontal distances to A and B from P were 60.3 m and 81.4 m respectively, and the reduced level of station P was 55.22 m, find the reduced levels of points A and B.