THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering

Bachelor of Technology (Civil) - Level 5
CEX 5230 - SURVEYING II

Final Examination - 2015/2016

Time Allowed **3 Hours**

Date: 04th December 2016 Time 09:30 - 12:30

This paper consists of ***Seven*** Questions. Answer ***Five*** Questions ***Only***.
Only the First Five Answered Questions appearing in the answer book will be evaluated.

All questions carry ***equal*** marks.

Q1.

a. A highway engineer proposed a simple circular curve to be constructed in a road project to connect two straights which intersect at A in a such a way that it is also tangential to the line joining points B and C lying on the two straights. Derive the following expression for this curve which is of radius *R*.

$$R = [\, s\,(s\text{-}a)\,(s\text{-}b)\,(s\text{-}c)]^{1/2} \,/\, (s\text{-}a)$$

Where *a*, *b* and *c* are the lengths of sides opposite to angles A, B and C respectively in the triangle ABC and the *s* is the semi perimeter. (Fig. 1)

b. Now the project engineer is to construct the simple curve by connecting the two straights XA and ZA, and also to touch the line BC. According to the survey measurements he gathered the lengths XB = 400 m, BA = 1200 m and CA = 1000 m, where the points of tangency on XA, ZA and BC are X, Z and Y respectively. According to his calculations the distance along the curve from X to Z is 1800 m. Determine whether the length he arrived from X to Z is correct.

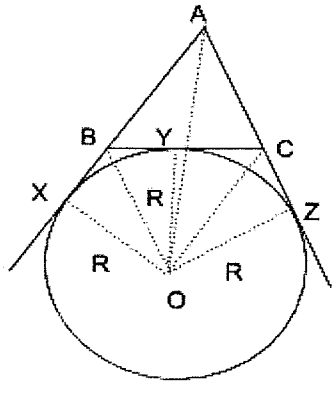

Fig.1

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Q2.

a. For the same road project the project engineer proposed to use a parabolic vertical curve at a certain location to overcome the topographical variations. The vertical curve is used to join a falling grade of 4.4% to a rising grade of 3.6%. The point of intersection of the two grades has a chainage of 4375 m and a reduced level of 163.42 m above mean sea level (MSL). The curve is required to have a reduced level of 164.40 m above MSL at the chainage of 4400 m in order to allow for adequate headroom. (Fig. 2) Determine the length of the vertical curve that should fulfil the requirements above and the chainage and the reduced level of its lowest point.

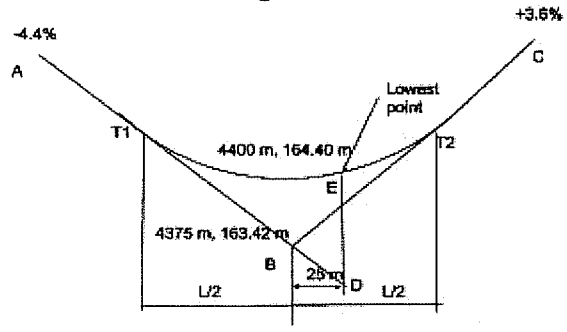

Fig. 2

b. Find the headlamp visibility distance when the headlamps are located 70 cm above the ground surface and if the headlamp beam of a vehicle makes an angle of +2° with the horizontal when standing on flat ground.

Hint: the following relationships for visibility, where h is the height of the headlamp (in meters) above the surface and θ° is the inclination of the beam above the road surface when the vehicle stands on the flat, may be used.
$L = S^2A/200(h+S \tan \theta°)$ *when* $S \leq L$, *and* $L = 2S - 200(h+S \tan \theta°)/A$ *when* $S \geq L$.

Q3.

a. Briefly explain types of errors that can occur in a survey with examples.

b. Fig. 3 shows measurement of three angles in a theodolite survey. If all angles are measured to the same accuracy as follows find the most probable values of angles a, b, and c.

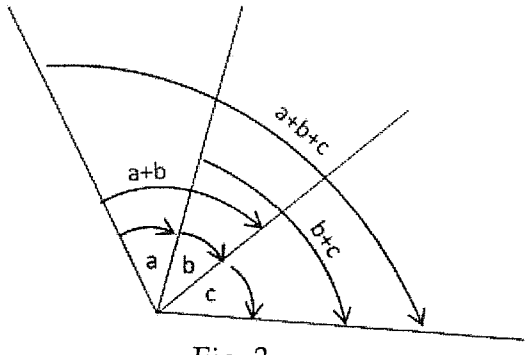

Fig. 3

$a = 43^0\ 35'\ 27.9"$
$b = 32^0\ 24'\ 43.4"$
$c = 40^0\ 50'\ 38.5"$
$a + b = 76^0\ 00'\ 13.0"$
$b + c = 73^0\ 15'\ 19.5"$
$a + b + c = 116^0\ 50'\ 47.3"$

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Q4.

a. Explain the meaning of following terms and indicate them on a sketch of a mass haul diagram.

i) Free haul distance
ii) Free haul volume
iii) Free haul

b. Table 1 shows the earthwork involved in each 100 m distance of a 1.4 km long road to be developed.

Chainage, m	0 -100	100 - 200	200 - 300	300 - 400	400 - 500	500 - 600	600 - 700
Cut volume (m^3)	2680	2200	790	85	---	---	---
Fill Volume (m^3)	---	---	---	450	1400	2750	2925
Chainage, m	700 - 800	800 - 900	900 - 1000	1000-1100	1100-1200	1200-1300	1300-1400
Cut volume (m^3)	---	---	500	1125	675	270	---
Fill Volume (m^3)	1450	650	65	---	---	---	50

Table 1

Construct the mass haul diagram for this project, assuming a swelling factor of 1.2 and calculate the free haul and over haul within this 1400 m length, if it is specified that the haul distance should not exceed 600 m. Consider the free haul distance as 400 m.

Q5.

a. Discuss ***three*** (3) applications of Geographical Information Systems.

b. Explain the following terms used in the global coordinate system of the world.

i) geodetic latitude
ii) geodetic longitude
iii) geodetic height

c. Explain how a GPS determines a location on earth and the information it needs for that.

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Q6.

a. Briefly discuss the steps involved in a Triangulation survey from the planning stage to adjustment of observed angles.

b. Mention ***three*** (3) conditions which need to be considered when selecting triangulation stations.

c. Explain why triangulation towers are need to be constructed in some triangulation surveys.

Q7.

a. Discuss the importance of Terrestrial Photogrammetry.

b. The horizontal angle between two points A and B was measured at station C and found to be $32^0\ 25'$. A photo theodolite set up at C and, on a photograph, A and B were found to be as shown in Fig. 4. (Dimensions are in mm)
If AC = 89 m and BC = 72 m, Determine;
   i) the focal length of the camera
   ii) and the difference in level between A and B

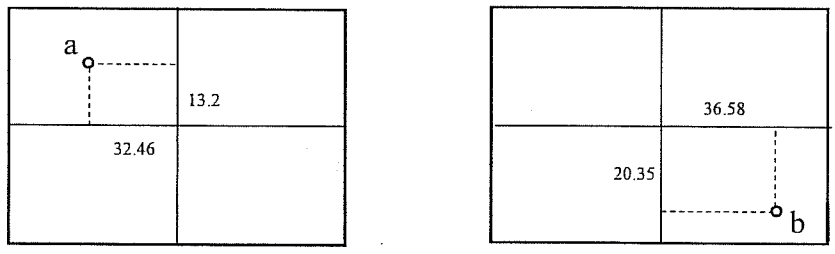

Fig. 4

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