00237

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CEX5230/CVX5530 Surveying II**
Academic Year	: 2017/18
Date	: 05 February 2019
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Seven (7)** questions in **Four (4)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. If you have **attempt more than five (05)** 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.**
5. Answer for each question should commence from a new page.
6. This is Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Q1.

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

(b) The Table Q1 below gives the earthwork for a proposed rural road project carried by a western provincial council. The road spans to a length of 1200 m and it is to be balanced along the stipulated stretch. The existing ground levels along the centre line of a road proposed to be developed, and the volumes of excavations and fill involved in making a formation that is rising at 1.2% from a level of 20.0 m at chainage of 1200 m.

Table Q1

Chainage (m)	1200		1300		1400		1500		1600
EGL (m)	29.1		33.7		30.0		24.6		22.1
Volume (m^3)		(+) 2350		(+) 1972		(+) 698		(-) 324	
Chainage (m)		1700		1800		1900		2000	
EGL (m)		19.0		16.5		19.4		26.0	
Volume (m^3)	(-) 1631		(-) 2555		(-) 2660		(-) 1397		(-) 367
Chainage (m)	2100		2200		2300		2400		
EGL (m)	30.8		37.5		38.8		41.5		
Volume (m^3)		(+) 654		(+) 1290		(+) 912			

i. Draw the longitudinal section of the existing ground (in black), and indicate the new formation (in blue). [3 Marks]

ii. Draw the mass-haul diagram for the proposed road, if the material encountered a swelling factor of 1.2. [3 Marks]

iii. Find 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. [3 Marks]

iv. Find the total free haul volume and the total over haul volume of the road project. [3 Marks]

Q2.

(a) A photo theodolite was setup at a station A to take a photograph of points P and Q, which are to be observed. On a photograph taken at station A, the point P was found to be 30.50 mm to the left of the vertical hair and 12.00 mm above the horizontal hair, while point Q 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 A, between two points P and Q was 25° 52' 30"and the horizontal distance to point P from station A is found to be 89.00 m.

i. Determine the focal length of the camera [4 Marks]

ii. Find the horizontal distance to point Q from station A, when the height difference of points P and Q is 15.65 m. [4 Marks]

iii. Find the reduced levels of point P and point Q, if the reduced level of the camera axis at station A is 68.86 m above MSL. [4 Marks]

(b) Derive a mathematical relationship to show the displacement of image in an aerial photograph due to ground relief. [4 Marks]

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(c) 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. [4 marks]

Q3.

(a) **Define** the following terms:

(i) A conditioned quantity [2 Marks]

(ii) The residual of an observed quantity [2 Marks]

(iii) The most probable value of an observed quantity [2 Marks]

(b) Rejection of observations is one method of treating of random errors. Briefly explain how you would consider rejecting an observed quantity. [4 Marks]

(c) The following set of reduced equations was obtained for a group of indirect 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 2)

(i) Write down normal equations for r_1, r_2 & r_3. [4 marks]

(ii) Solve for r_1, r_2 & r_3. [2 marks]

If the measured value of the angle A (corresponds to r_1) is 35º 12' 30", determine its corrected value. [4 marks]

Q4.

(a) Explain different types of networks used in triangulation survey. [4 Marks]

(b) Briefly explain commonly used geometrical conditions to adjust the above triangulation networks. [4 Marks]

(c) Write down all the condition equations for a single triangular network consists of a polygon with a central hub (see Figure Q4.) [6 Marks]

(d) Describe in steps how you would proceed to compute the coordinates of the other stations of the polygon with central hub network, if the coordinates of a point A and the bearing of line AB are known. [6 Marks]

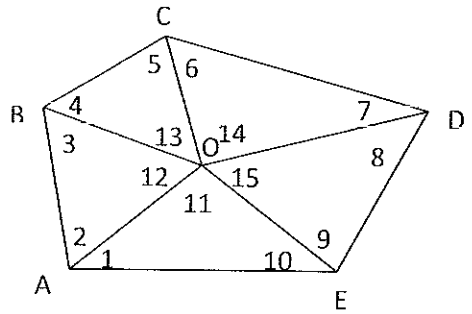

Figure Q4.

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Q5.

(a) Discuss the three major components (or segments) that support the Global positioning system to function as a precise positioning tool in GIS.

[3 Marks]

(b) State the three main geodetic datum types and explain the following terms with reference to any of the geodetic datum type.

i). Datum Shifts

ii). Datum Conversions [5 Marks]

(c) It is necessary to have accurate measurements for precious positioning. Discuss the predictable accuracy of two services PPS and SPS and their use respectively.

[4 Marks]

(d) With reference to precise positioning in GPS, to minimise errors occurring is important as much as improving the accuracy of the service. Discuss the different error sources that cause to reduce the accuracy of GPS.

[8 Marks]

Q6.

(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 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.

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

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 (Figure Q6). [8 Marks]

(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.

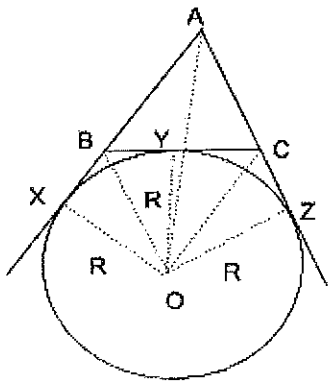

Figure Q6

[12 Marks]

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Q7.

(a) For the same road project discussed in Q6., 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 (Figure Q7). Determine the length of the vertical curve that should fulfil the requirements above and the chainage and the reduced level of its lowest point.

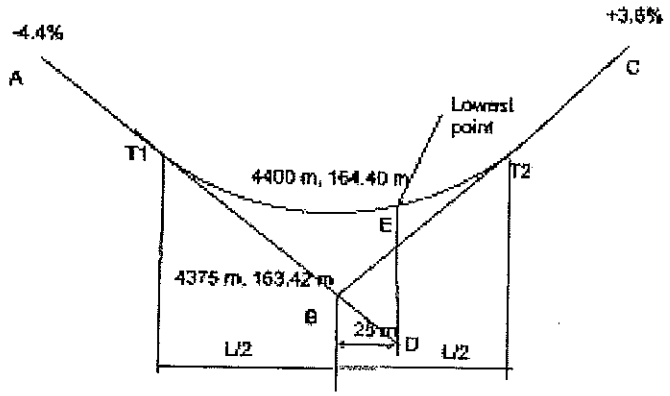

Figure Q7

[12 marks]

(b) Find the headlamp visibility distance when the headlamps are located 70 cm above the ground surface along a sag 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* $S \geq L$.

[8 marks]