

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



Study Programme	: Bachelor of Science Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: CVX5440 Surveying II
Academic Year/Semester	: 2024/2025
Date	: 24 th February 2026
Time	: 13:30-16:30h
Duration	: 3 hours

Read all instructions carefully before answering the questions.

1. This question paper consists of **six (6)** questions.
2. Answer **for any five(05) questions**
3. Answer for each question should commence from a new page.
4. This is a **Closed Book Test (CBT)**.
5. Answers should be in clear hand/ writing.
6. Do not use red-coloured pens. Only non-programmable calculators are allowed.

Question 1

1. Explain the types of horizontal curves used in road construction with the clear figures and characteristics. (6 marks)
2. In the horizontal alignment of a highway, two parallel straight sections of the centreline are 200 m apart (measured perpendicular to the alignment). To provide a smooth change in direction, the straights are to be connected by a reverse horizontal curve consisting of two simple circular curves with the radius of 400m and 600m. The first circular curve subtends a central angle of 36°.
 - i) Determine the central angle of the second circular curve required to connect the two parallel straights. (3 marks)
 - ii) Calculate the length of each circular curve and hence determine the total length of the reverse curve along the highway centreline. (4 marks)
3. Two straight line portions with whole-circle bearings of 35°20' and 105°45' are to be connected by a circular curve of radius 700 m. The chainage of the intersection point is 2520.00 m. Calculate the chainages of the tangent points. (7 marks)

Question 2

1. Briefly discuss the basic requirements in the design of transition curve. (3 marks)
2. Consider a parabolic sag curve in a road construction project with 2.5% falling gradient and 3.5% rising gradient. The horizontal length of the curve is 80 m. by considering the beginning of the curve as an origine of the cartesian plane.
Develop the equation for the curve (assume $y = ax^2 + bx + c$) (10 marks)

3. The points A, B, C, D and E shown in Figure Q2 represent a traverse whose coordinates are known with respect to the East and North axes in one system. It is now necessary to transform these coordinates to another system whose axes are E' and N' . The E and N axes are formed by shifting the origin by amounts E_0 and N_0 respectively, and then rotating through α degrees in the clockwise direction. If E and N are the coordinates of any point on the traverse, what are the coordinates of that point with respect to the E' and N' ? (7 marks)

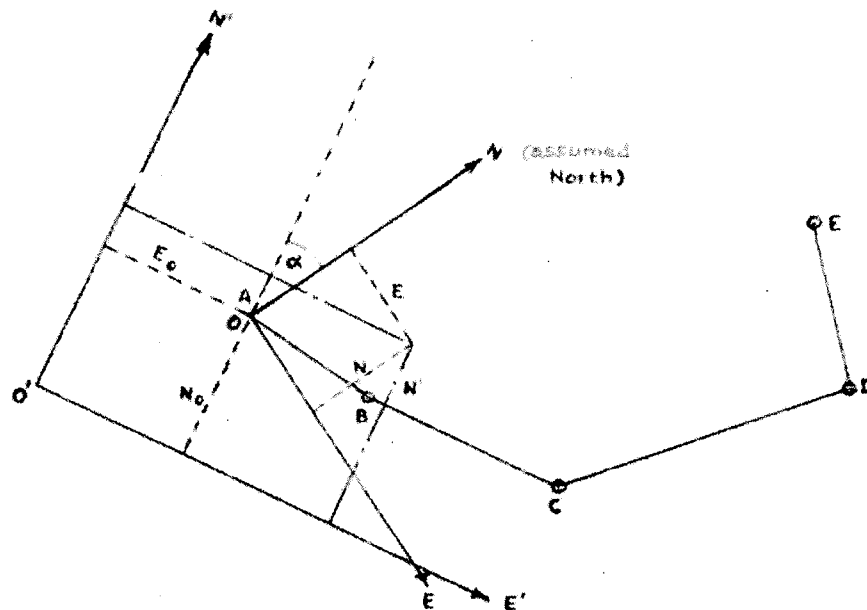


Figure. Q2: Transformation of Coordinates

Question 3

1. Explain the main types of networks used in triangulation survey. (4 marks)
2. Briefly explain commonly used geometrical conditions to adjust the any triangulation networks. (4 marks)
3. Write down all the condition equations for a single triangular network consists of a polygon with a central hub (refer figure Q3) (6 marks)

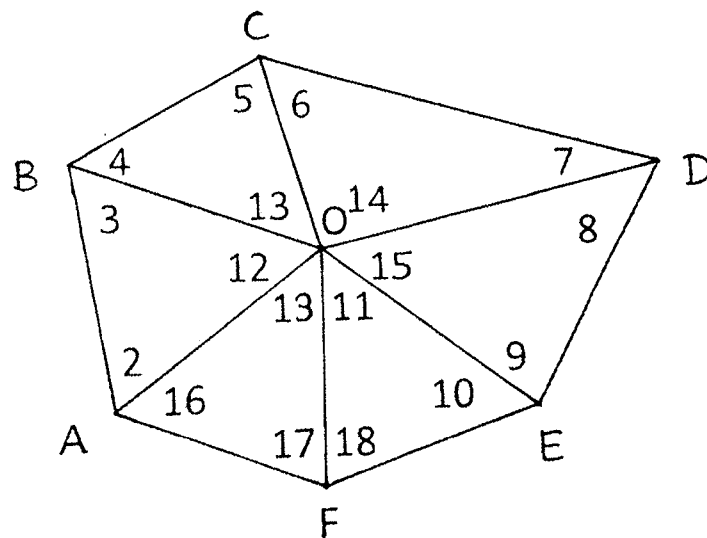


Figure Q3

4. Above Figure Q3 represents the horizontal control network for construction sites. 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)

Question 4

1. Rejection of observations is one method of treatment of random errors. Explain how you do that? (3 marks)
2. During the triangulation survey, the angle ABC was measured by three different observers using different instruments.
 Observer 1: $110^{\circ} 15' 10''$ (Weight 2)
 Observer 2: $110^{\circ} 15' 20''$ (Weight 3)
 Observer 3: $110^{\circ} 15' 05''$ (Weight 1)
 Calculate the most probable value of the angle ABC. (4 marks)

3. The following are the mean values observed in the measurement of three angles X, Y, and Z at a station.

X	$76^{\circ} 42' 46.2''$	Weight 4
X+Y	$134^{\circ} 36' 32.6''$	Weight 3
Y+Z	$185^{\circ} 35' 24.8''$	Weight 2
X+Y+Z	$262^{\circ} 18' 10.4''$	Weight 1

Calculate the most probable value of each angle using normal equation. (7 marks)

4. The following set of reduced equations was obtained for a group of indirect observed independent angles.

$$\begin{aligned}
 r_1 &= 0 \text{ (weight 1)} \\
 r_2 &= 0 \text{ (weight 1)} \\
 r_3 &= 0 \text{ (weight 1)} \\
 r_1 + r_2 - 1.0 &= 0 \text{ (weight 2)} \\
 r_2 + r_3 + 1.5 &= 0 \text{ (weight 2)} \\
 r_1 + r_2 + r_3 + 0.5 &= 0 \text{ (weight 2)}
 \end{aligned}$$

- (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]

Question 5

1. What is Remote Sensing? Explain the concept behind Remote Sensing (4 marks)
2. A Unmanned Aerial Vehicle (UAV) photogrammetry survey is being planned to acquire high resolution topographic data for the design of a new reservoir. Explain, in detail and sequentially, the key steps involved in planning this UAV survey project? (6 marks)
3. Define a Geographic Information System (GIS) and state what are the applications that can be performed using GIS? (5 marks)
4. Discuss how modern surveying techniques are applied in one of the following works.
 highway and railway alignment design,
 construction monitoring and deformation analysis,
 earthwork quantity estimation and progress control. (5 marks)

Question 6

- 1 Briefly explain the four main cost components of earth movement. (6 marks)
- 2 Explain the importance of mass-haul diagram in earthwork involved in road and railway construction. (3 marks)
- 3 Explain the importance of using bulking or shrinkage factor in earthwork computation (3 marks)
- 4 Figure Q6 shows a section of the mass haul diagram for a project. The free haul distance is stipulated as 300 m, and the charges for earth moving are as follows. ($pq=rs=300\text{m}$)
 Cost of free haul = 1500 LKR per m^3
 Cost of over haul = 2000 LKR per m^3
 Cost of waste = 2800 LKR per m^3
 [note that the cost is given for unit volume, and not for unit haul]
 Calculate **the total cost**, if the material wasted at the 900m is 270 m^3 .

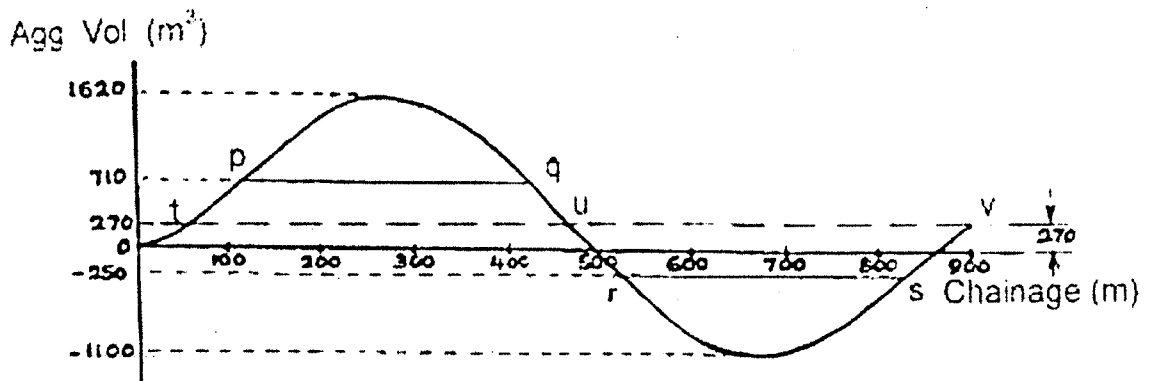


Figure Q6: Mass haul diagram

(8 marks)