

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	: 03 rd March 2025
Time	: 1330-1630h
Duration	: 3 hours

Read all instructions carefully before answering the questions.

1. This question paper consists of **Seven (7)** 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 colour pen.

Question 1:

1. Two straight line portions with whole-circle bearings of $30^\circ 20'$ and $85^\circ 45'$ are to be connected by a circular curve of radius 650 m. The chainage of the intersection point is 2040.00 m. Calculate the chainages of the tangent points. (8 marks)
2. Referring to the following **figure Q1** derive the expression for **m**, ($EF=m$) by which the point of tangency is shifted in the direction parallel to the second tangent. (6 marks)

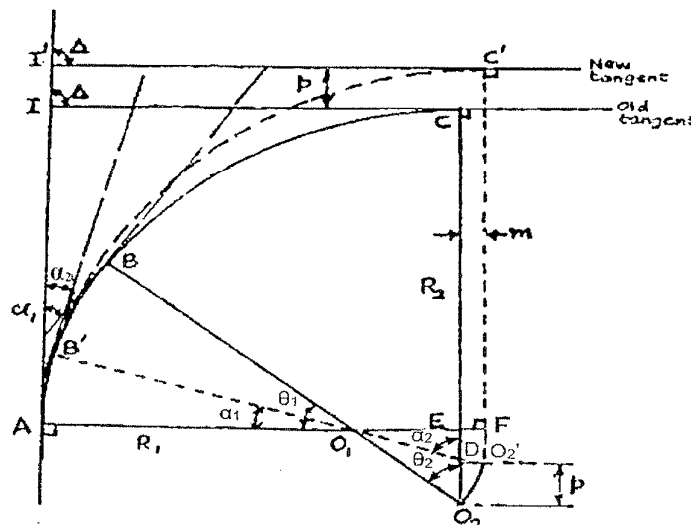


Figure Q1: Modifying a curve

- Two parallel tangents are spaced 200 m (perpendicular to the parallel line) and are connected by a reverse curve with radii 400 m (with 40°) and 500 m. Calculate the angles subtended by the radius 500 m arc and the total length of the reverse curve.

(6 marks)

Question 2

- Briefly discuss the factors influencing the choice of curve length in road and railway design.
- A road curve is designed for a speed of 100 km/h with a centrifugal ratio of 0.25. The radius of the circular arc is 315 m, and the maximum allowable rate of change of radial acceleration is 0.3 m/s^3 .

Calculate the length of the transition curve

$$L = V^3 / (46.66 cR)$$

(4 marks)

- Consider a parabolic vertical summit curve ADB (Figure. Q2) connecting a rising grade ACH (+g₁ %) to a falling grade CB (-g₂ %).

The first tangent point is taken as the origin and x and y are measured horizontally and vertically respectively, the equation of the curve is,

$$y = ax^2 + bx + c \text{ (where } a, b, \text{ and } c \text{ are constants)}$$

Derive the following equation for the vertical curve assuming it is to be a parabola.

$$y = -\left\{ \frac{g_1 + g_2}{200L} \right\} x^2 + \frac{g_1}{100} x$$

If the grade angle is α find an expression for mid offset CD.

(12 marks)

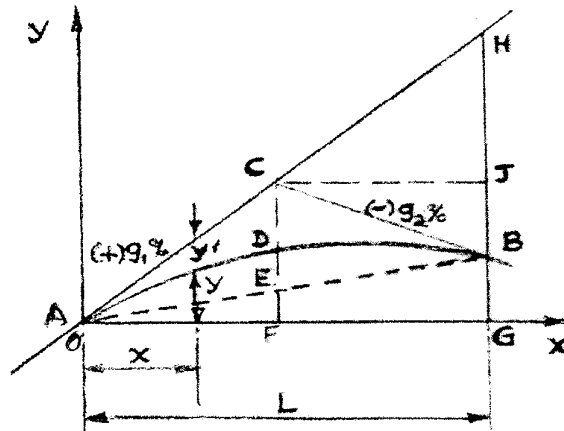


Figure. Q2: Vertical curve in a cartesian plane.

Question 3.

- Explain modern surveying techniques and future trends in surveying.
- Discuss different conditions prevailing in tunnel surveying compared to surface surveying and how to overcome these challenges.
- According to the correlation survey between wires in each of two shafts A and C shown in Figure Q3, the following partial coordinates were obtained. (refer table Q3)

Table Q3: Observed Departure and Latitude for AB and BC

Line	Departure, m	Latitude, m
AB	119.662	-9.105
BC	79.498	13.958

Find AC grid bearing and the AC length. If coordinates of point A is (4425,5175) find the Coordinates of C.

Question 4

1. Explain the significance of minimizing errors in surveying and treatment of random errors.
(6 marks)
2. explain the rejection of observations.
The following readings were taken in angle measurement. Calculate the mean of the observed angle after rejecting abnormal values.
(6 marks)

Table Q4: Angle measurements

68° 08' 32.25"	68° 08' 33.75"	68° 08' 31.25"
68° 08' 31.00"	68° 08' 35.50"	68° 08' 34.25"
68° 08' 34.50"	68° 08' 33.25"	68° 08' 32.00"
68° 08' 36.75"	68° 08' 35.50"	68° 08' 33.50"
68° 08' 48.50"	68° 08' 39.00"	68° 08' 40.25"
68° 08' 33.75"	68° 08' 32.50"	68° 08' 37.25"
68° 08' 51.25"	68° 08' 37.50"	68° 08' 38.25"
68° 08' 34.00"	68° 08' 33.50"	68° 08' 36.25"
Mean angle: 68° 08' 36.06"		
Standard deviation: 4.91"		

3. The following three angles, α , β , and γ , were observed from station P, forming a closed horizon. Their respective probable errors of measurement are also mentioned with the angle. Determine their corrected values.
 $\alpha = 98^\circ 12' 12''$ error range $\pm 2''$
 $\beta = 126^\circ 48' 30''$ error range $\pm 4''$
 $\gamma = 134^\circ 59' 08''$ error range $\pm 5''$
 (8 marks)

Question 5

1. Briefly explain the following
 1. classification of triangulation surveys
 2. triangulation reconnaissance
 (8 marks)
2. Figure Q5 shows a triangular network in which the angles marked 1-14 have been measured with the same degree of precision. The length AB has also been measured. Write down all the condition equations.
(6 marks)

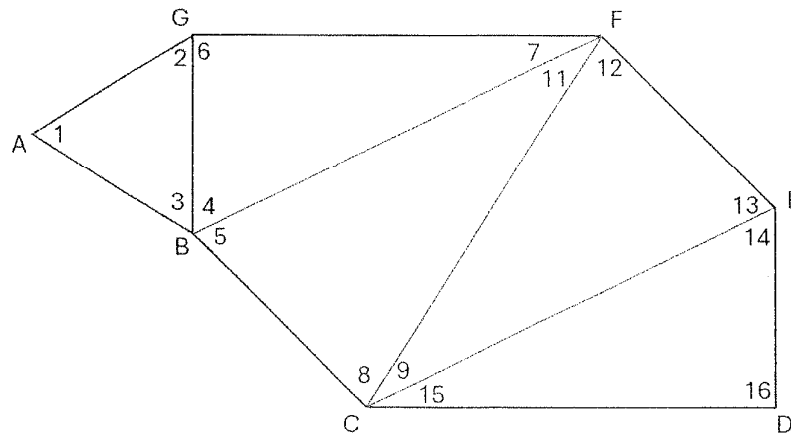


Figure Q5 : Triangular network

3. Describe in steps how you would proceed to compute the coordinates of the other stations of the network, if the coordinates of point A and the bearing of line AB are known.
(6 marks)

Question 6

- Briefly explain the following terms
 - Average haul distance
 - Free haul distance
 - Over haul distance
 (6 marks)
- Briefly explain four cost components of earth moving (6 marks)
- 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 = Rs. A per m^3
 Cost of over haul = Rs. C per m^3
 [note that the cost is given for unit volume, and not for unit haul]
 Cost of waste = Rs. E per m^3
 Calculate the **total cost**, if the material wasted at the 900m is 270 m^3 .

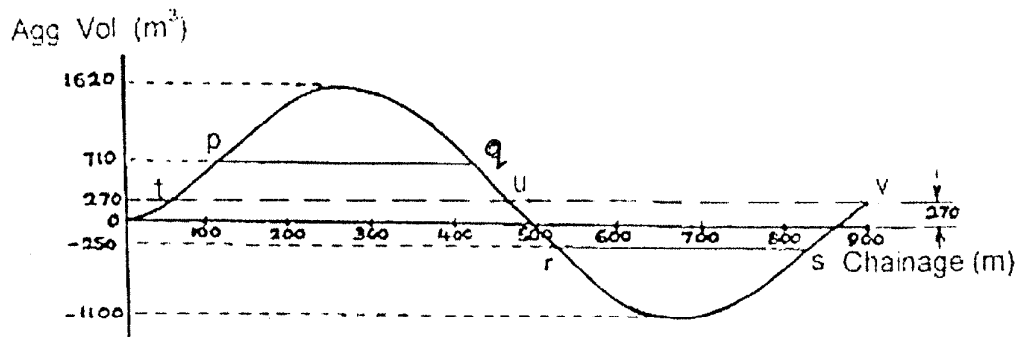


Figure Q6: Mass haul diagram

(8 marks)

Question 7

- What are Geographic Information Systems and explain its usage in civil engineering (5 marks)
- Briefly explain the term remote sensing (3 marks)
- The Figure Q7 shows a tilted photograph taken on a flat terrain. The photograph possesses a tilt of θ . Derive the following basic equation for scale along the principal line. (12 marks)

$$S = (f \pm y \sin \theta) / (H - h)$$

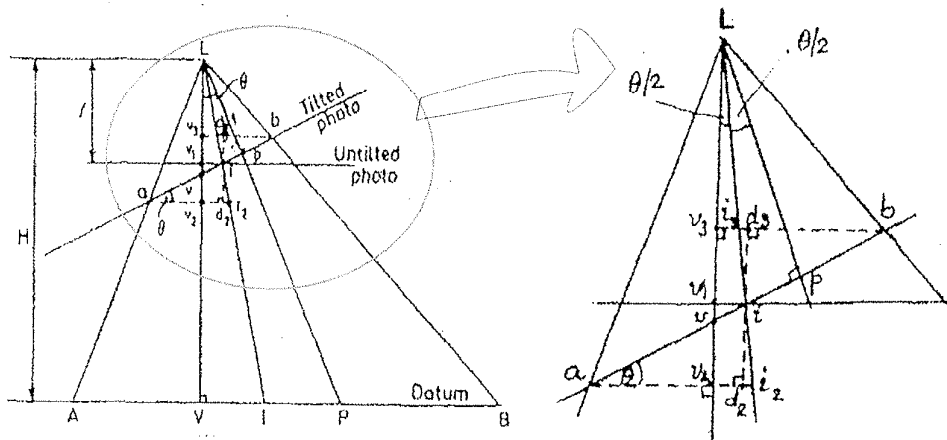


Figure Q7: Left: Tilted photograph taken on a flat terrain, Right: Enlarged figure around L