9	a)	Explain in detail about the different types of E.D.M instruments.	L2	CO4	5 M
	b)	Describe about Drone survey and LiDAR Survey.	L2	CO4	5 M
		UNIT-V			
10		Describe the contents of specifications for terrestrial photogrammetry.	L2	CO5	10 M
		OR			
11	a)	Distinguish between aerial triangulation and radial triangulation.	L2	CO5	5 M
	b)	Describe ground control extension for photographic mapping in detail.	L2	CO5	5 M

PVP 23

Code: 23CE3301

II B.Tech - I Semester – Regular Examinations - DECEMBER 2024

SURVEYING
(CIVIL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	List the accessories of plane table.	L1	CO1
1.b)	What is Magnetic Declination?	L1	CO2
1.c)	What is meant by the reduction of levels?	L1	CO1
1.d)	Write the formula for Simpson's rule.	L1	CO3
1.e)	List any three uses of theodolite.	L1	CO1
1.f)	Distinguish between Line of Collimation and Line of Sight.	L2	CO2
1.g)	What are the advantages of reverse curves?	L1	CO4
1.h)	Write any two advantages of Total station.	L1	CO4
1.i)	What is radial triangulation?	L1	CO5
1.j)	What you meant by Photogrammetry Survey?	L1	CO5

PART – B

			BL	CO	Max. Marks
		UNIT-I			
2	a)	Explain different methods of plane Surveying? Under what circumstances they are preferred? Also give salient features of these methods.	L2	CO1	5 M
	b)	Distinguish between W.C.B and Q.B systems.	L2	CO1	5 M
		OR			
3	a)	What is local attraction? Explain how the bearings are corrected for local attraction.	L2	CO1	5 M
	b)	Explain different types of tape corrections.	L2	CO2	5 M
		UNIT-II			
4	a)	Explain the temporary adjustments of a leveling.	L2	CO2	4 M
	b)	Describe different indirect methods of locating a contour? Write about any one method in detail.	L2	CO2	6 M
		OR			
5		A railway embankment 800m long is 15m wide at the formation level and has the side slope 2 to 1. The ground levels at every 200m along the center line are as under.	L3	CO3	10 M

		Distance	0	200	400	600	800		
		R.L	202.8	208.2	209.5	208.2	211.3		
		The formation level at zero chainage is 207.00 and the embankment has a rising gradient of 1 in 100. The ground is level across the center line. Calculate the volume of earth work using Trapezoidal and Prismoidal rule.							
		UNIT-III							
6		A theodolite was set up at a distance of 200m from a tower. The angle of elevations to the top of the tower was 8°18' while angle of depression was 2°24'. The staff reading on the BM of RL 248.362m with the telescope horizontal was 1.286m. Find the height of the tower and RL of the top of the tower.						L3	CO1	10 M
		OR							
7	a)	Explain traversing methods and describe how adjustment will be done.						L2	CO2	5 M
	b)	Explain reiteration method to find horizontal angles.						L2	CO1	5 M
		UNIT-IV							
8		What is meant by degree of a curve? Explain the different methods of designating a curve? Derive a relationship between the degree of a curve and its radius.						L2	CO4	10 M
		OR							

II B. TECH / I SEM / End Examination-Regular- Dec 2024
23CE3301-SURVEYING
(CIVIL ENGINEERING)
Scheme of valuation

PART-A

1 a) List the accessories of plane table.
List of accessories: (2 mark)

1 b) What is Magnetic Declination?
Definition of magnetic declination (2 marks)

1 c) What is meant by the reduction of levels?
Definition of reduction of levels (2 marks)

1 d) Write the formula for Simpson's rule.
Simpson's rule formula: (2 marks)

1 e) List any three uses of theodolite.
Listing three uses: (2 marks)

1 f) Distinguish between Line of Collimation and Line of Sight.
Line of Collimation: (1 mark)
Line of Sight: (1 mark)

1 g) What are the advantages of reverse curves?
List two or three advantages: (2 marks)

1 h) Write any two advantages of Total station.
List two advantages: (2 marks)

1 i) What is radial triangulation?
Definition and brief explanation: (2 marks)

1 j) What you meant by Photogrammetry Survey?
Definition and purpose of photogrammetry: (2 marks)

PART-B

2 a) Explain different methods of plane Surveying? Under what circumstances they are preferred? Also, give salient features of these methods.

- Introduction to plane surveying: (1 marks)
- Description of methods (chain, compass, plane table survey, etc.): (2 marks)
- When each method is preferred with reasons: (1 marks)
- Salient features of each method: (1 mark)

2 b) Distinguish between W.C.B and Q.B systems.
W.C.B systems (2.5 marks)
Q.B systems (2.5 marks)

3 a) What is local attraction? Explain how the bearings are corrected for local attraction.
Local attraction (2 marks)
Explanation through bearings (3 marks)

3b) Explain different types of tape corrections.

Tape correction (1 mark)

Its types with relavent formulas (4 marks)

4 a) Explain the temporary adjustments of a leveling.

- Purpose of temporary adjustments: 1 marks)
- Detailed explanation of each adjustment (instrument level, line of sight, etc.): (3marks)
- Precautionary measures: (1 marks)

4 b) Describe different indirect methods of locating a contour? Write about any one method in detail

- Introduction to indirect methods: (1 marks)
- List of methods (tilting level, EDM, etc.): (2 marks)
- Detailed explanation of one method: (2 marks)

5 A railway embankment 800m long is 15m wide at the formation level and has the side slope 2 to 1. The ground levels at every 200m along the center line are as under.

0	**200**	**400**	**600**	**800**
R.L	**202.8**	**204.2**	**209.5**	**208.2**

The formation level at zero chainage is 207.00 and the embankment has a rising gradient of 1 in 100. The ground is level across the center line. Calculate the volume of earthwork using Trapezoidal and Prismoidal rule.

Given data (2 marks)

Process and Detailed solution using the Trapezoidal rule: (4 marks)

Process and Detailed solution using the Prismoidal rule: (4 marks)

6 A theodolite was set up at a distance of 200m from a tower. The angle of elevations to the top of the tower was 8°18' while the angle of depression was 2°24'. The staff reading on the BM of RL 248.362m with the telescope horizontal was 1.286m. Find the height of the tower and RL of the top of the tower.

- Given data (2 marks)
- Calculating height using trigonometric formulas: (5 marks)
- Calculation of RL for the top of the tower: (3 marks)

7 a) Explain traversing methods and describe how adjustment will be done.

Explanation of different traversing methods (open, closed, etc.): (5 marks)

7 b) Explain reiteration method to find horizontal angles.

Explanation of different reiteration method (2 marks)

Procudure with figure (3 marks)

8 What is meant by degree of a curve? Explain the different methods of designating a curve? Derive a relationship between the degree of a curve and its radius.

- Definition of degree of a curve: (2 marks)
- Explanation of curve designation methods (e.g., radius, degree): (4 marks)
- Derivation of the relationship: (4 marks)

9 a) Explain in detail about the different types of E.D.M instruments.

Intro & Definition (2 marks)

List 3 types with features, advantages, and applications. (3 marks)

9b) Describe about Drone survey and LiDAR Survey

Drone Survey Intro, Advantages & Applications (3 marks)

LiDAR Survey, Applications of LiDAR (2 mark)

10 Describe the contents of specifications for terrestrial photogrammetry.

- Intro (2 marks)
- Specifications (6 marks): Camera, survey area, accuracy, post-processing.
- Deliverables (2 marks): Types of final outputs (maps, 3D models).

11a) Distinguish between aerial triangulation and radial triangulation.

Aerial Triangulation (2.5 marks)

Radial Triangulation (2.5 marks)

11b) Describe ground control extension for photographic mapping in detail.

Intro (1 marks)

Process (3 marks)

Accuracy (1 marks)

II B. TECH / I SEM / End Examination-Regular- Dec 2024
23CE3301-SURVEYING
(CIVIL ENGINEERING)

PART-A

1 a) List the accessories of plane table.

Drawing board
Alidade
Spirit level
Compass
Tripod
Plumb bob
U-frame or Trough Compass
Drawing sheets and pins

1 b) What is Magnetic Declination?

Magnetic Declination is the angle between the magnetic meridian (indicated by the magnetic needle) and the true meridian (geographic north). It varies from place to place and over time.

1 c) What is meant by the reduction of levels?

Reduction of levels refers to the process of calculating the reduced levels (RL) of different points with respect to a reference point or benchmark. It is done using leveling instruments to determine the relative heights of various points.

1 d) Write the formula for Simpson's rule.

The formula for Simpson's rule is:

$$\int_a^b f(x)\,dx = \frac{1}{3}h\left[y_0 + y_n + 4(y_1 + y_3 + \ldots + y_{n-1}) + 2(y_2 + y_4 + \ldots + y_{n-2})\right]$$

where $h = \frac{b-a}{n}$, $y_r = f(x_r)$ and n is even.

1 e) List any three uses of theodolite.

- Measuring horizontal and vertical angles
- Aligning points in surveying
- Establishing benchmarks and transferring levels

1 f) Distinguish between Line of Collimation and Line of Sight.

- **Line of Collimation:** It is an imaginary line passing through the optical center of the telescope and the crosshairs.
- **Line of Sight:** It is a straight line drawn from the observer's eye through the instrument to the target point

1 g) What are the advantages of reverse curves?

- Reverse curves provide smooth alignment between two roads or railways having opposite curvatures.
- They are used to adjust to terrain conditions or obstacles.

- They minimize sudden changes in direction for smoother vehicle movement.

1 h) Write any two advantages of Total station.

- High accuracy in measuring distances, angles, and coordinates.
- Combines surveying, data collection, and digital storage into one instrument, reducing manual errors.

1 i) What is radial triangulation?

Radial triangulation is a method in surveying where a central point (reference station) is used to measure angles to multiple surrounding points. It helps establish positions of those points using triangulation techniques.

1 j) What you meant by Photogrammetry Survey?

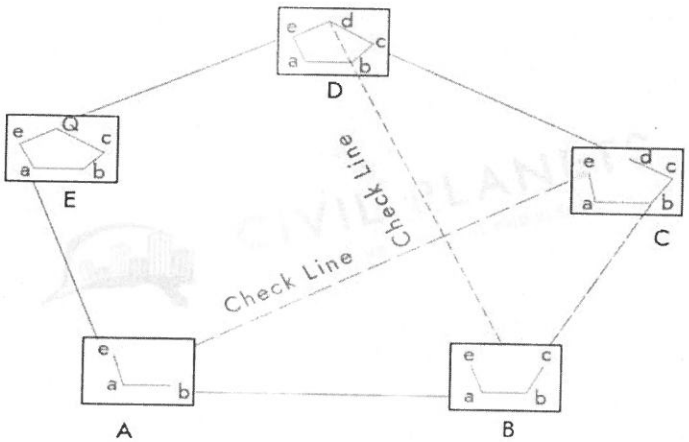
Photogrammetry Survey is the process of obtaining accurate measurements and mapping from photographs taken from aerial or ground-based cameras. It is widely used for topographic mapping and 3D modeling.

PART-B

2 a) Explain different methods of plane Surveying? Under what circumstances they are preferred? Also, give salient features of these methods. 5 M

Methods of plane table surveying and when they are used:

- Radiation: Observations are taken towards the points that need to be detailed. This method is used to locate a point.
- Intersection: This method is used to locate a point.
- Resection: This method is used to locate the table.
- Traversing: This method is used in both radiation and resection.



Plane table surveying is a graphical method that involves simultaneously plotting plans and making field observations. It's a quick and easy method that's well-suited for small-scale surveys, such as industrial areas. It's also used to fill in details

between stations that have been surveyed using more precise methods like theodolite traversing or triangulation.

Advantages of plane table surveying:

Simultaneous plotting and field work: Reduces the chance of omitting details.
Direct comparison: Plotting details can be compared to the actual objects in the field.
Cheaper than theodolite survey: Plane table surveying is a simpler and cheaper method than theodolite survey.

2 b) Distinguish between W.C.B and Q.B systems. 5 M

Sr. no.	Whole Circle Bearing	Quadrant Bearing/Reduced Bearing
1.	The horizontal angle made by a line with the Magnetic north in the clockwise direction is known as the whole circle bearing of the line.	The horizontal angle made by a line with the magnetic north or south (whichever is closer from the line) in the eastward or westward direction is the Quadrant Bearing or Reduced Bearing of the line.
2.	Only the magnetic north line is considered as reference line in whole circle bearing system.	Both magnetic north & south lines are considered as reference line in quadrant bearing system.
3.	Direction of angle or bearings is always taken in clockwise direction.	Direction of angle or bearings may be clockwise or anticlockwise depends upon conditions.
4.	The value of the whole circle bearing varies from 0° to 360°	The value of the reduced bearing varies from 0° to 90°
5.	e.g. 26°, 121°, 245°, 350° etc.	e.g. N26°E, S59°E, S65°W, N10°W etc.

3 a) What is local attraction? Explain how the bearings are corrected for local attraction. 5 M

Local attraction is when a compass needle deviates from true magnetic north due to the presence of magnetic objects nearby. These objects can include iron pipes, electric cables, steel girders, and more.

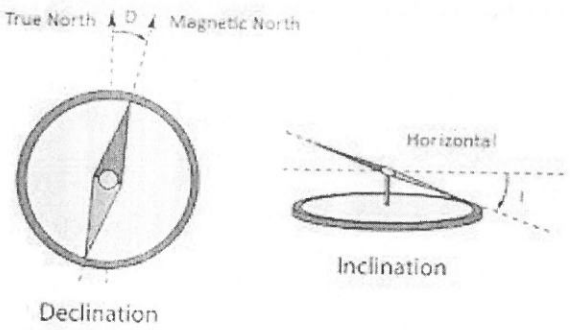
To correct bearings for local attraction, you can start from an unaffected line and calculate the correct bearings for the lines that follow. You can detect local attraction by comparing the fore bearing and back bearing of a line:

- **No local attraction**

  If the difference between the fore and back bearings is exactly 180°, then there is no local attraction at either station.

- **Local attraction**

  If the difference between the fore and back bearings is not 180°, then local attraction exists at one or both ends of the line.



3b) Explain different types of tape corrections. 5 M

In surveying, tape corrections are used to correct measurements for the following effects:

- **Temperature:** A tape's length increases as its temperature rises, so a correction is required to ensure the measured distance is accurate.
- **Sag:** The tape's sag varies with the applied tension.
- Slope: The slope angle of the measurement needs to be taken into account.
- **Absolute length:** The absolute length of a tape is usually expressed as its nominal length plus or minus a correction.
- **Tension:** The tension or pull on the tape needs to be accounted for.

A correction is positive when the uncorrected length needs to be increased, and negative when it needs to be decreased.
Failing to correct for these effects results in systematic errors, which are predictable and can be corrected mathematically.

$$e_{sl} = L_m \times \left(\frac{L_s - L_n}{L_n} \right)$$

standardisation length (actual tape length)

nominal length (assumed tape length)

$$e_{tension} = \frac{(T - T_s)L_m}{E \times A}$$

Tension applied

Standardisation tension

Modulus of Elasticity of tape material For steel, E = 200,000 N/mm²

Cross section Area

The correction of the tape length due to change in temperature is given by:

$$C_t = C \cdot L(T_m - T_s)$$

4 a) Explain the temporary adjustments of a leveling. 4 M

The temporary adjustments of a leveling instrument are the operations that need to be performed before each measurement to ensure the accuracy and precision of the results. These adjustments are:

- **Setting**: Set up the tripod stand at a convenient height and make sure the head is horizontal.
- **Leveling**: Adjust the tripod legs to level the top of the table.

- **Focusing**: Adjust the eyepiece until the crosshairs and target are clear and sharp.
- **Collimation**: Sight a distant target and rotate the instrument until the crosshairs are aligned with the target.
- **Centering**: Sight a distant target and rotate the instrument until the crosshairs remain stationary in the field of view.

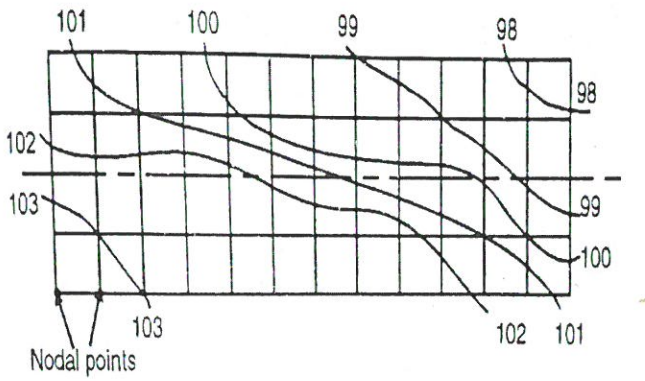
Temporary adjustments are especially important when the instrument will be used for a long time or in challenging environmental conditions.

4 b) Describe different indirect methods of locating a contour? Write about any one method in detail. 6 M

Indirect method- In this method, spot level is taken at the regular interval along predetermine line on the ground the work is then plotted on plan and then the required contour line is drawn by the process of interpolation. The indirect method is less tedious and speedy as compared to the direct method. The method fallow in the indirect method of contouring is.

By cross-section- This method is suitable for road, railway and canal survey. consider X, Y, Z as the centre line of the road or railway or canal as shown in fig. the cross section is set at every 10m on the centre line whereas the other dimension to complete a rectangle may be 5m.

By squares (block contouring)- In this method the area to be surveyed is dividing into no of the square of size 5 to 20m.depending upon the nature of ground and contour interval required. The elevation of the corner of the square is determined by the mean of the process of levelling. The calculated RL of this nodal point is them written on the respective noddle points. And contours are interpolated between them.



By tachometric method- In the case of hilly area tachometric contouring method is used. Here the instrument known as tachometer which is theodolite is utilized which determine horizontal distance and elevation of the point.

5 **A railway embankment 800m long is 15m wide at the formation level and has the side slope 2 to 1. The ground levels at every 200m along the center line are as under.**

0	200	400	600	800
R.L	202.8	204.2	209.5	208.2

The formation level at zero chainage is 207.00 and the embankment has a rising gradient of 1 in 100. The ground is level across the center line. Calculate the volume of earthwork using Trapezoidal and Prismoidal rule. 10 M

Given Data:

1. Length of embankment (L): 800 m
2. Formation width (B): 15 m
3. Side slope (S): 2 horizontal : 1 vertical (i.e., S = 2)
4. Gradient: 1 in 100 (rising gradient)
5. Ground levels (R.L):
   - At 0 m → 202.8
   - At 200 m → 204.2
   - At 400 m → 209.5
   - At 600 m → 208.2
   - At 800 m → 211.3
6. Formation level at zero chainage (0 m): 207.00
   - Rising gradient → the formation level increases by 1 m for every 100 m.

ıtep 1: Calculate Formation Levels

he formation level at any point along the embankment can be calculated as:

$$\text{Formation Level at Distance } x = \text{Formation Level at } 0\,m + \left(\frac{x}{10}\right.$$

Distance (m)	Formation Level (R.L)
0	207.00
200	$207 + \frac{200}{100} = 207 + 2 = 209.00$
400	$207 + \frac{400}{100} = 207 + 4 = 211.00$
600	$207 + \frac{600}{100} = 207 + 6 = 213.00$
800	$207 + \frac{800}{100} = 207 + 8 = 215.00$

Step 2: Calculate Depth of Cutting or Filling

The depth is the difference between the **Formation Level** and the **Ground Level**:

$$\text{Depth} = \text{Formation Level} - \text{Ground Level}$$

Distance (m)	Formation Level (R.L)	Ground Level (R.L)	Depth (m)
0	207.00	202.8	$207.00 - 202.8 = 4.2$
200	209.00	204.2	$209.00 - 204.2 = 4.8$
400	211.00	209.5	$211.00 - 209.5 = 1.5$
600	213.00	208.2	$213.00 - 208.2 = 4.8$
800	215.00	211.3	$215.00 - 211.3 = 3.7$

Step 3: Calculate Cross-Sectional Area

The cross-sectional area for an embankment is given by:

$$A = B \times D + S \times D^2$$

Where:

- B = Formation width = 15 m
- D = Depth of embankment
- S = Side slope = 2

We calculate the areas at each point:

Distance (m)	Depth (D) (m)	Area (A) (m^2)
0	4.2	$15 \times 4.2 + 2 \times (4.2)^2 = 63 + 35.28 = 98.28$
200	4.8	$15 \times 4.8 + 2 \times (4.8)^2 = 72 + 46.08 = 118.08$
400	1.5	$15 \times 1.5 + 2 \times (1.5)^2 = 22.5 + 4.5 = 27.0$
600	4.8	$15 \times 4.8 + 2 \times (4.8)^2 = 72 + 46.08 = 118.08$
800	3.7	$15 \times 3.7 + 2 \times (3.7)^2 = 55.5 + 27.38 = 82.88$

Step 4: Calculate Volume Using Trapezoidal Rule

The formula for the volume using the Trapezoidal Rule is:

$$V = \frac{d}{2}\left[A_1 + 2(A_2 + A_3 + \cdots + A_{n-1}) + A_n\right]$$

Where:

- d = Interval = 200 m
- $A_1, A_2, \ldots A_n$ are the cross-sectional areas.

Substitute the values:

$$V = \frac{200}{2}\left[98.28 + 2(118.08 + 27.0 + 118.08) + 82.88\right]$$

Simplify step by step:

1. $118.08 + 27.0 + 118.08 = 263.16$
2. $2 \times 263.16 = 526.32$
3. $98.28 + 526.32 + 82.88 = 707.48$
4. $V = 100 \times 707.48 = 70748\,\text{m}^3$

Step 5: Calculate Volume Using Prismoidal Rule

The formula for the volume using the Prismoidal Rule is:

$$V = \frac{d}{3}\left[A_1 + 4(A_2 + A_4) + 2(A_3) + A_5\right]$$

Substitute the values:

$$V = \frac{200}{3}\left[98.28 + 4(118.08 + 118.08) + 2(27.0) + 82.88\right]$$

Simplify step by step:

1. $118.08 + 118.08 = 236.16$
2. $4 \times 236.16 = 944.64$
3. $2 \times 27.0 = 54.0$
4. $98.28 + 944.64 + 54.0 + 82.88 = 1179.8$
5. $V = \frac{200}{3} \times 1179.8 = 78653.33\,\text{m}^3$

- Volume **using Trapezoidal Rule:** 70748 m^3
- Volume **using Prismoidal Rule:** 78653.33 m^3

6 **A theodolite was set up at a distance of 200m from a tower. The angle of elevations to the top of the tower was 8°18' while the angle of depression was 2°24'. The staff reading on the BM of RL 248.362m with the telescope horizontal was 1.286m. Find the height of the tower and RL of the top of the tower. 10 M**

Given Data:

1. Distance to the tower (D): $200\,m$
2. Angle of elevation to the top of the tower: $8^\circ 18'$
   - Convert to decimal degrees: $8^\circ 18' = 8 + \frac{18}{60} = 8.3^\circ$
3. Angle of depression to the base of the tower: $2^\circ 24'$
   - Convert to decimal degrees: $2^\circ 24' = 2 + \frac{24}{60} = 2.4^\circ$
4. Staff reading on BM with the telescope horizontal: $1.286\,m$
5. RL of the Benchmark (BM): $248.362\,m$

Step 1: Calculate the Vertical Height for Elevation (Top of Tower)

The vertical height h_1 corresponding to the angle of elevation can be found using:

$$h_1 = D \cdot \tan(\theta_1)$$

Where:

- $D = 200\,m$
- $\theta_1 = 8.3^\circ$

Substitute the values:

$$h_1 = 200 \cdot \tan(8.3^\circ)$$

Using a calculator:

$$\tan(8.3^\circ) = 0.1453$$

$$h_1 = 200 \cdot 0.1453 = 29.06\,m$$

↓

Thus, the vertical height from the telescope horizontal line to the top of the tower is $29.06\,m$.

Step 2: Calculate the Vertical Height for Depression (Base of Tower)

The vertical height h_2 corresponding to the angle of depression can be found using:

$$h_2 = D \cdot \tan(\theta_2)$$

Where:

- $\theta_2 = 2.4^\circ$

Substitute the values:

$$h_2 = 200 \cdot \tan(2.4^\circ)$$

Using a calculator:

$$\tan(2.4^\circ) = 0.04196$$

$$h_2 = 200 \cdot 0.04196 = 8.39\,m$$

Thus, the vertical height from the telescope horizontal line to the base of the tower is $8.39\,m$.

Step 3: Determine the Total Height of the Tower

The total height of the tower H is the sum of:

1. The vertical height to the top of the tower (h_1)
2. The vertical height to the base of the tower (h_2)
3. The staff reading on the BM ($1.286\,m$)

$$H = h_1 + h_2 + \text{staff reading}$$

Substitute the values:

$$H = 29.06 + 8.39 + 1.286 = 38.736\,m$$

Step 4: Determine the RL of the Top of the Tower

The RL of the top of the tower is the sum of:

1. RL of the Benchmark (BM)
2. The total height of the tower (H)

$$\text{RL}_{\text{top}} = \text{RL}_{\text{BM}} + H$$

Substitute the values:

$$\text{RL}_{\text{top}} = 248.362 + 38.736 = 287.098\,m$$

Final Answers:
Height of the tower: $38.74\,m$
RL of the top of the tower: $287.10\,m$

7 a) Explain traversing methods and describe how adjustment will be done. 5 M

Traversing methods are used to survey a series of connected lines of known lengths and directions, called a traverse. Some traversing methods include:

Theodolite traversing

Uses a theodolite to calculate the angles at each traverse station, and then measures the traverse legs by direct chaining. This method is used to calculate the relative positions of points on the earth's surface.

Chain traversing

Uses a chain and tape to fix the directions of the lines, without measuring angles.

Compass traversing

Uses a magnetic compass to measure angles. However, the accuracy of this method is limited by the limitations of the magnetic compass.

Plane table traversing

Similar to compass or theodolite traversing, but the table is set at each station. This method is best for surveying narrow strips of terrain, such as roads or railways.

Some methods for adjusting a traverse include:

Transit method: Used when angular measurements are more precise than linear measurements closed and opened traverse method.

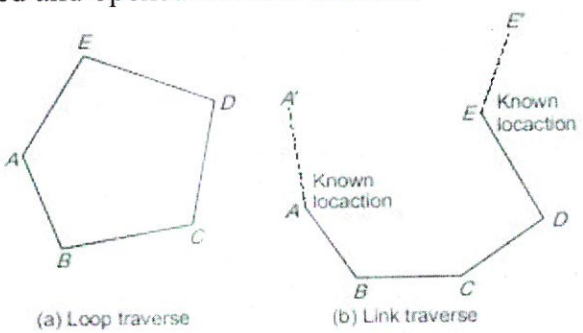
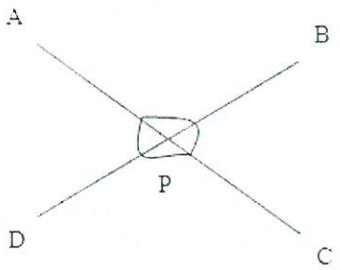


Fig: Closed traverse

7 b) Explain reiteration method to find horizontal angles. 5 M

The reiteration method is a technique for measuring horizontal angles that involves measuring angles in succession from a single instrument station. It's used when multiple angles need to be measured with high precision. The steps for using the reiteration method are:

- Start at an initial station and measure angles successively
- The final observation is the angle between the initial station and the terminating station
- To close the horizon, turn the instrument 360° and bring the line of sight back to the initial station
- If there are no discrepancies, the final reading of the vernier should be the same as its initial reading
- The reiteration method is precise and less tedious than other methods. It's also useful for improving the accuracy of measurements by canceling out systematic errors. The arithmetic mean of the observations gives the true value of the angle.



8 What is meant by degree of a curve? Explain the different methods of designating a curve? Derive a relationship between the degree of a curve and its radius. 10 M

The degree of a curve is a measure of the curvature of a circular curve. It represents the angle subtended at the center of the curve by a chord or arc of a specific length.

This is commonly used in highway and railway engineering for designing horizontal curves.

There are two common definitions of the degree of a curve:

Degree of a curve (chord definition):

It is the angle subtended at the center of the curve by a chord of 30 meters (100 feet). This definition is widely used in railway and highway design.

Degree of a curve (arc definition):

It is the angle subtended at the center of the curve by an arc of 30 meters (100 feet).

Methods of Designating a Curve

The curve can be designated or defined using two main methods:

1. **By Radius of the Curve (R)**
2. **By Degree of the Curve (D)**

Relationship Between the Degree of a Curve and Its Radius

To derive the relationship between the **degree of a curve** D and its **radius** R, we consider the following:

For the Chord Definition:

- D is the angle subtended at the center of the curve by a **chord of length 30 meters (100 feet)**.
- Using trigonometry, for small angles, the radius R is related to the chord length L and degree D as follows:

$$\text{Length of arc} = 2\pi R \cdot \frac{D}{360^\circ}$$

For a 30-meter (or 100-foot) chord, we approximate the relationship as:

$$R = \frac{30}{2\sin\left(\frac{D}{2}\right)} \quad \text{(Chord definition)}$$

For small angles, $\sin(\theta) \approx \theta$ (in radians), so:

$$\sin\left(\frac{D}{2}\right) \approx \frac{\pi D}{360^\circ}$$

Thus, substituting and simplifying:

$$R = \frac{30}{2 \cdot \frac{\pi D}{360}} = \frac{30 \cdot 360}{2\pi D} = \frac{5400}{\pi D}$$

Using $\pi \approx 3.1416$:

$$R = \frac{5400}{3.1416D} \approx \frac{1719}{D} \text{ (in meters for a 30 m chord).}$$

Final Relationship:

The relationship between the **degree of a curve (D)** and its **radius (R)** is:

$$R = \frac{1719}{D} \quad \text{(in meters for a chord definition of 30 m)}$$

Or, rearranging:

$$D = \frac{1719}{R}$$

9 a) Explain in detail about the different types of E.D.M instruments. 5 M

Electronic Distance Measurement (EDM) instruments are classified by the type of electromagnetic wave they use to measure distance. The three main types of EDM instruments are:

- **Microwave instruments**

Also known as tellurometers, these instruments have been in use since the 1950s.

- Use **microwave signals** for measuring long distances (up to 100 km).
- Moderate accuracy (±10 mm).
- Example: **Tellurometer**.

- **Infrared wave instruments**

These instruments use prism reflectors to pick up amplitude modulated infrared waves at the end of a line.

- Use **infrared light waves** reflected by prisms for medium distances (up to 3 km).
- High accuracy (±2 mm to 10 mm).

- **Visible light wave instruments**

These instruments use modulated light waves to measure up to a specific range.
EDM instruments use the propagation, reflection, and reception of light waves or radio waves to measure distances and directions. They have improved the precision and efficiency of modern surveying tasks

- Use **laser beams** for short to medium distances (up to 2.5 km).
- Very high accuracy (±1 mm to 5 mm).
- Example: **Total Station**.

EDM instruments provide **fast and accurate measurements**, making them ideal for surveying applications.

9b) Describe about Drone survey and LiDAR Survey. 5 M

Drone Survey

Definition: Drone survey involves using **Unmanned Aerial Vehicles (UAVs)** equipped with cameras or sensors to capture aerial data.

Working Principle: Drones fly over the survey area and collect high-resolution images or videos, which are processed to create **3D maps** or **topographic models**.

Advantages:

1. Quick data collection over large areas.
2. Cost-effective compared to traditional methods.
3. Provides high-resolution aerial imagery.

Applications: Land mapping, construction site monitoring, agriculture, and disaster management.

LiDAR Survey (Light Detection and Ranging)

Definition: LiDAR is a remote sensing technology that uses **laser pulses** to measure distances and generate precise **3D point clouds**.

Working Principle: A LiDAR sensor emits laser beams, and the time taken for the reflected light to return is measured to determine distances.

Advantages:

1. High accuracy (centimeter-level precision).
2. Penetrates vegetation to detect ground surfaces.
3. Works effectively in challenging terrains.

Applications: Forestry, flood modeling, urban planning, mining, and infrastructure development.

10 Describe the contents of specifications for terrestrial photogrammetry. 10 M

Specifications for Terrestrial Photogrammetry

1. **Camera Specifications:**

High-resolution digital or analog cameras with calibrated lenses.
Sensor details such as pixel resolution and focal length.

2. **Control Points:**

Adequate number of ground control points using GPS or total stations.
High accuracy and proper distribution to ensure reliable results.

3. **Baseline and Station Setup:**

Proper spacing (baseline length) between two camera stations.
Convergence angles between images (30° to 90°) for accurate depth.

4. **Image Overlap:**

Forward overlap (60%-70%) and side overlap (30%-40%) for complete coverage.

5. **Calibration of Instruments:**

Lens distortion, focal length, and scale calibration for accuracy.

6. **Lighting Conditions:**

Sufficient lighting to avoid shadows and ensure clear image capture.

7. **Data Processing:**

Use of software for creating 3D models, maps, or digital elevation models (DEMs).
Defined accuracy standards and error tolerance levels.

8. **Deliverables:**

Final outputs include orthophotos, 3D models, contour maps, and detailed reports.
These specifications ensure precise and consistent results in terrestrial photogrammetry surveys.

11a) Distinguish between aerial triangulation and radial triangulation. 5 M

Differences Between Aerial Triangulation and Radial Triangulation

Aspect	Aerial Triangulation	Radial Triangulation
Definition	A process of determining coordinates by using overlapping aerial images taken from different positions.	A process where the direction of objects or points is determined with respect to the center of a photograph.
Data Source	Uses multiple aerial photographs captured from aircraft or drones.	Relies on a **single photograph** with directions radiating from the center point.
Coverage	Covers **large areas** with overlapping photographs.	Covers a smaller area using only one image.
Accuracy	High accuracy due to multiple photographs and control points.	Accuracy is lower compared to aerial triangulation.
Application	Used for creating large-scale maps and models in photogrammetry.	Used for **small-scale mapping** and locating features quickly.
Overlapping Requirement	Requires **forward and side overlaps** between photos for stereoscopic vision.	No overlap is required; data relies on the geometry of a single image.
Control Points	Needs multiple ground control points for accurate triangulation.	Requires fewer control points, as directions are radial.

11b) Describe ground control extension for photographic mapping in detail. 5 M

- **Ground control extension** involves extending known ground control points (GCPs) across the survey area.
- GCPs have precise coordinates and are used to georeference photographs to real-world positions.
- The process starts with a few known control points, extended using **aerial triangulation** or **radial triangulation**.
- **Aerial triangulation** uses overlapping photographs to transfer control across a larger area.
- **Photo control points** are identified on photographs and matched with ground control points.
- The extension process reduces the need for extensive fieldwork and enables mapping large or inaccessible areas.
- The **accuracy** depends on the number and distribution of control points.
- Ground control extension is used for creating accurate **digital elevation models (DEMs), topographic maps**, and **3D models**.
- It is widely applied in **urban planning, land surveys**, and **infrastructure development**.

This technique ensures reliable georeferencing for various photogrammetric applications.