INSTITUTE OF REMOTE SENSING

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LAB MANUAL

TOTAL STATION AND GPS SURVEYING

TABLE OF CONTENTS

Expt No. 1	STUDY OF TOTAL STATION	Date of Expt:

AIM:

To study the function and working of Total Station.

DESCRIPTION:

A total station (TS) is an electric/optic instrument used for surveying, for taking linear and angular measurements with high level of accuracy. It is an electronic (or) digital transit theodolite integrated with Electronic distance measurement (EDM) to measure vertical angles, horizontal angles and slope distance from the instrument to a particular point and an on-board computer to collect data and perform triangulation calculations.

FIELD PROCEDURE FOR TOTAL STATION SURVEY:

1. Leveling the total station:
   Leveling the total station must be accomplished to sufficient accuracy otherwise the instrument will not report result. Make sure you can see all the targets from the instrument station before going through the process
   i) Tripod setup:
   Tripod legs should be equally spaced. Tripod head should be approximately level. Head should be directly over survey point.
2. Mount Instrument on Tripod:
   Place instrument on tripod. Secure with centering screw while bracing the instrument with the other hand. Insert battery in instrument before leveling.
3. Focus on Survey point:
   Focus the optical plummet on the survey point.
4. Leveling the instrument:
   Adjust the leveling foot screws to centre the survey point in the optical plummet reticle. Centre the bubble in the circular level by adjusting the tripod legs. After re-tightening the centering screw check to make sure that the plate level bubble is level bubble is level in several directions.
5. Electronically verify leveling:
   Turn on the instrument by passing and holding the ‘ON’ button. The opening screen will be the “MEAS” screen. Select the [Tilt] function. Adjust the foot. Rotate the instrument 90° and repeat.
6. Adjust image and Reticle focus:
   Adjust the reticle (ie cross-hair) focus adjustment until reticle image is sharply focused. Point telescope to target and adjust the focus ring until target is focused. Move your hand from side to side to test for image shift(parallax). Repeat the rticle focus step if the parallax is significant.

WORKING OF SALIENT PARTS:

Handle: To carry the instrument physically

Bluetooth Antenna: To communicate via Bluetooth wireless technology.

External interface batch: To connect to external devices

Instrument height mark: To measure height of instrument

Luminance Sensor: Adjust the brightness of screen automatically.

Guide light: To carry out setting out measurement effectively.

Laser pointer; function: To sight a target in dark location softly in bold type on the screen.

Trigger: Key to carry out operation indicated by the softkey in bold type on the screen

Tribranch clamp: Clamp the upper part of the instrument with lower part.

Sighting collimator: To aim in the direction of measurement point.

- A total station primarily consists of an electronic theodolite, an EDM, Microprocessor and many other accessories.
- Body of a theodolite is divided into 2
  Upper part- the alidade
  Lower part- the tribranch
- Alidade includes standards, telescope, EDM, circles (horizontal, vertical) and other elements for measuring angles and distance.
- Tribranch contains foot screws, circular level, clamping device and trends.

Telescope:

- Objective lens: Focus on the object to form image at plane of reticle.
- Eye piece lens: Focus on the plane of reticle
- Axis(or)line of sight: Line joining the objectives lens and the eyepiece lens.
- Parallax: If there is relative motion between image formed and reticle. Parallax is present which should be avoided.
- Lock and target screws: for revolutions and rotations all to focus.
  It makes the telescope focus automatically to target. After aiming the telescope to the target autofocus bottom get pressed.

ANGLE MEASUREMENT SYSTEM:

For horizontal angle measurement, 2 glass circle within the alidade are mounted parallel one on the top of other, with a slight spacing between them.

In a leveled TS, horizontal angle circles should be in horizontal plane. For vertical angle measurement, 2 more glasses circles are mounted in 11^{e1} with right spacing between them but aligned in a vertical plane automatically in a leveled TS.

MICROPROCESSOR:

Controls, measures, computers. Reduces observation data by providing commands through keyboard.

AUTOMATIC COMPENSATOR:

To get TS precisely indexed with the direction of gravity. Automatically align vertical circles having 0°; oriented precisely upward towards the zemth.

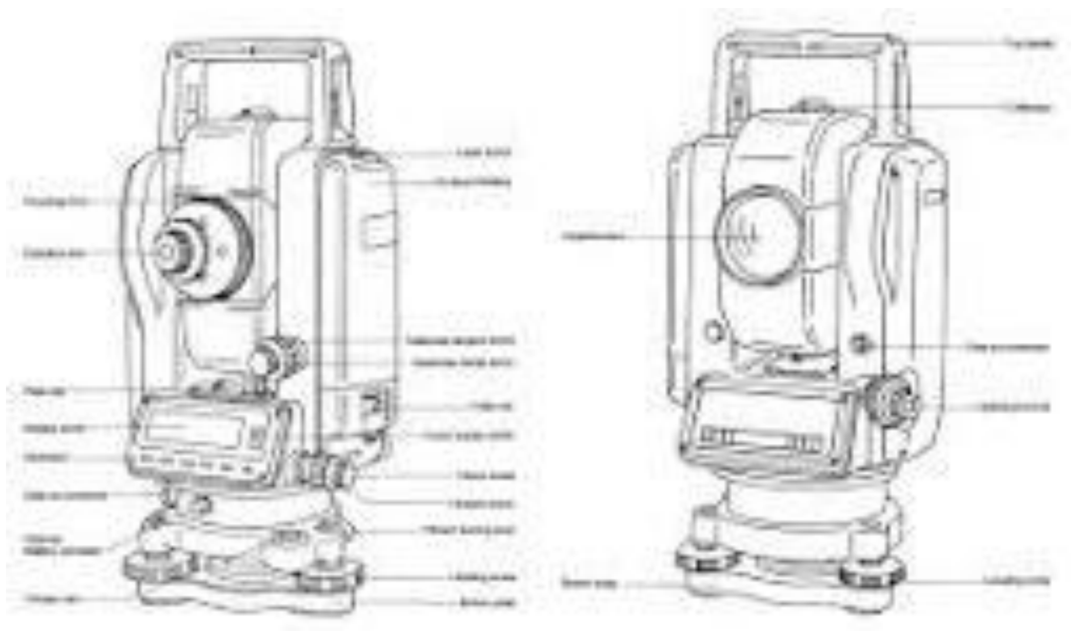
PLUMMET:

Build into either alidade or tribranch provides a lines of sight that is directed downwards. Collinear with the vertical axis after leveling. For accurate centering Laser variety provides a beam of colliniated light

OPTICAL GUIDANCE SYSTEM:

One or 2 above or below the telescope tube at the end, of the objective lens. These are light emitting divides and emit a visible light patterns which enables a detail. Pole to be set directly on the line of sight and at the correct distance without the need for hand signals from the TS.

PARTS OF TOTAL STATION:



RESULT:

Hence, the parts, function and working, terminologies are studied.

Expt No. 2	DISTANCE AND COORDINATE MEASUREMENT	Date of Expt:

AIM:

To measure the coordinates of a given area of land with instrument at same station

APPARATUS REQUIRED:

Total station-Main Frame

Tripod

Measuring tape

Prism

THEORY:

Angles and distances are measured from the total station to points under survey and the coordinates (x, y, z) or (Easting, Northing, Elevation) of surveyed points relative to the total station are calculated using Triangulation.

The distances are measured quite accurately using total station and the horizontal and vertical distance components of the measured slope distances are calculated using vertical angle.

PROCEDURE:

- The total station is kept at point ‘O’ and centering and levelling are done.
- Create a new job and input the reference (Northing and Easting).
- Place prism facing the North and focus the point as B.S Point and measure it.
- Choose a given grounded area and focusing the prism center at eye-piece at all the boundary edge points, click on ‘Measure’ and ‘store’ the point. The points will automatically be stored in sequential order.
- In the right corner, click on ‘Map’ and check the display of the surveyed ground area.
- Select ‘Jobs’ and click on ‘Point manager’ and click and check the list of all measured points and their corresponding Lat/Long co-ordinates.

OBSERVATION:

POINT	ID	NORTHING	EASTING

RESULT:

Hence,the coordinates of the edges of the given area is stored and the distance from the station point is also measured.

Expt No. 3	MISSING LINE MEASUREMENT	Date of Expt:

AIM:

To find the distance between two points A and B from another point ‘O’ (Instrument Position).

APPARATUS REQUIRED:

- Total station-Main frame
- Tripod
- Prism
- Prsim pole
- Measuring Tape

THEORY:

- It is the process of finding the distance between two points A and B, which are not inter-visible from each other from another point(O)[Instrument position]
- It is also known as RDM-Remote distance Measurement.

PROCEDURE:

- The instrument is positioned over point ‘O’ and the primary adjustments are carried out.
- A new job is then created and reference values of (Northing, Easting and Elevation) are given as input.
- With the prism at point A, the values are measured and similarly the same procedure is carried out at point B by focussing the eye-piece at the prism center.
- Now the distance is measured by selecting ‘Compute distance’ from CoGo option.
- The distance measured by the instrument is later cross-checked by measuring the distance between the two points using measuring tape.

OBSERVATION:

POINT	NORTHING (m)	EASTING (m)	ELEVATION (m)

RESULT:

Thus the distance between the two points A and B are measured from the point O where the instrument is placed. The distance between A and B are found using total station.

Expt No. 4	REMOTE ELEVATION MEASUREMENT	Date of Expt:

AIM:

To find the height of the target which is remotely located.

INSTRUMENT REQUIRED:

1. Total station & it’s accessories.
2. Target

PROCEDURE:

- This method is used to measure the height of the object (can be tower, gallery, etc.) which are remotely located.
- Do the preliminary adjustments (centering, leveling) and setup the instrument station point ‘o’.
- Now focus the object whose height needs to be measured.
- Now to setup the instrument at pt ‘o’, go to general survey -> job -> Give a name for the job.
- Now select Measure-> M3 -> Station setup. The inst. height as 1.330m
- After which go to back sight -> Target Direct (DR). This option is used since we are not using optical prism. Only the reflected rays from the object reach the instrument again.
- After this enter the station name for the backsight point, then sight the target.
- We are now taking base him measurement for which we need focus 90° (i.e.) vertical angle should be exactly 90°0'0" use the mirror adjustment screws to bring it to 90°0'0".
- Now, wait, until the distance is measured
- Now, sight the upper part of the target-object. Select Measure
- Now, the instrument displays the height of the target inclusive of Bench mark.
- Since, the bench mark value in already known to be 10m the height of the target is found by subtracting 10m from the displayed height.

OBSERVATION:

RESULT:

Hence the height of the object which is remotely located is calculated using REM.

Expt No. 5	RESECTION	Date of Expt:

AIM:

To find the location (or) coordinates of the instrumental station using the reflection points.

INSTRUMENTS REQUIERED:

1. Total Station kits accessories
2. Reflector
3. Tripod stand
4. Arrows

PRINCIPLE:

Using the given reference points A and B, the position coordinate of the instrument station(s) is located.

PROCEDURE:

- With the help of two given points, the instrument station’s coordinate is to found
- For which initially, the instrument was placed at a point ‘o’ and the 5 points which are marked by arrows are slighted. (i.e.) The arrows are replaced by prism (reflectors) with stand.
- The points A, B, C, D, E are sighted from the instrument station ‘o’ and the distance OA, OB, OD, OE slope and horizontal and vertical angles were measured by the instrument. The inst. station coordinate was assumed to (5000.N.5000 Eashing0
- Now , we have found the coordinates of the points A,B,C,D,E (known coordinates)
- The above steps include only the situation to find the location of the points 9ie0 known points
- (Now the instrument must be shifted to another station) The instrument is mounted on point ‘S’ Now, do the leveling, centering is not required as it’s just a random point.
- Now, Select Measure->M3->Resection. Enter the name of the point (inst. station as ‘s’)
- Measure the inst. height using tape and input into the device.
- Now enter the point name as A. Meanwhile hold the prism at point ‘A’. click Measure. Likewise do for another point say B. Two points are enough to locate the instrument station
- Finally, select ‘Result’ to the position of the instrument station(new). It also displays the error and orientation correction

TABULATION:

PT	HORIZONTAL ANGLE	VERTICAL ANGLE	SLOPE DISTANCE	HORIZONTAL DISTANCE	VERTICAL DISTANCE	N	E	ELEVATION

RESULT:

The position of the instrument station is located finally.

Expt No. 6	SETTING OUT: POINT AND LINE	Date of Expt:

AIM:

To perform the setting out of a point and a line using a Total Station for accurate surveying.

INSTRUMENTS REQUIRED:

- Total Station (with accessories: prism, tripod, etc.)
- Prism rod
- Measuring tape
- Reflector (for Total Station measurements)
- Tripod (for mounting the Total Station)
- Computer/Software for data recording (optional)
- Surveying notebook for manual recording
- Field markers (optional, for marking the point and line)

PRINCIPLE:

The principle of setting out a point and a line with a Total Station involves using angular and distance measurements. A Total Station combines the functions of a theodolite and an electronic distance measuring device (EDM). The Total Station helps determine the position of a target (point) by measuring the horizontal and vertical angles and distances from the instrument's setup location.

To set out a point, the Total Station is directed to the given coordinates, and the position is marked on the ground. For setting out a line, the Total Station uses two or more known points to align a straight line on the field.

PROCEDURE:

1. **Instrument Setup:**
   - Set up the Total Station over a known reference point (control point) on the ground. Ensure that the instrument is level and properly centered over the control point using the levelling bubble.
   - Ensure that the instrument is calibrated and connected to the prism.
2. **Measuring Angles and Distances:**
   - In the case of setting out a **point**, input the coordinates (Eastings, Northings, and Elevation) of the target point into the Total Station.
   - Aim the Total Station to the target point, and use the prism to reflect the signal. The instrument will calculate the angle and distance to the target point and display the readings.
3. **Setting Out a Point:**
   - Align the prism at the calculated position of the point and check the accuracy of the instrument by verifying the measurements.

   - If the instrument provides the correct coordinates for the point, mark the location using a survey marker or flag.
4. **Setting Out a Line:**
   - For setting out a line, measure the required angle and distance from one known point to another.
   - Use the Total Station to establish the direction of the line by setting the angle and measuring the distance between the two points.
   - Mark the points along the line on the ground using the prism and survey markers at regular intervals or based on the required accuracy.
5. **Observation and Adjustment:**
   - Repeat measurements and check if the angles and distances are correct.
   - Make minor adjustments by re-aiming the Total Station if necessary to ensure precision.

TABULATION:

S. No.	**Point/Line**	**Measured Horizontal Angle (°)**	**Measured Vertical Angle (°)**	**Distance (m)**	**Target Coordinates (E, N, Elevation)**	**Remarks**

RESULT:

The correct position for the set-out point is identified and marked on the ground. The straight line is established with the required coordinates, and intermediate points along the line are marked accurately. The setting-out exercise shows the effective use of Total Station for precise measurement and alignment.

Expt No. 7	TAKING OFFSETS	Date of Expt:

AIM:

To perform the task of taking offsets using a Total Station, by measuring the perpendicular distance (offset) from a line or reference point to a specific target or feature in the field.

INSTRUMENTS REQUIRED:

- **Total Station** (with accessories like prism, tripod, etc.)
- **Prism Rod** (for reflecting signals to the Total Station)
- **Measuring Tape** (for additional manual measurements, if required)
- **Reflector** (for Total Station measurements)
- **Tripod** (for mounting the Total Station)
- **Surveying Notebook** (for data recording)
- **Field Markers** (for marking measured points)
- **Data Recording Device** (optional, for digital data entry)

PRINCIPLE:

The Total Station works by combining the functions of a theodolite (measuring angles) and an electronic distance measuring (EDM) instrument (measuring distances). When taking offsets, the principle involves measuring the perpendicular distance from a feature or object (e.g., a building, fence, or boundary) to a reference line or point, often using the Total Station to calculate both angular and linear measurements with high precision.

Offsets are generally measured when the target point is not directly along a survey line but at some distance perpendicular to it. The Total Station allows this by first determining the direction of the reference line and then measuring the offset distance at various points along the feature.

PROCEDURE:

1. **Instrument Setup:**
    - Select a known reference point or line in the survey area.
    - Set up the Total Station at a suitable position with a clear line of sight to both the reference line and the target feature.
    - Level the instrument and ensure it is centered over the survey point using the levelling bubble.

2. **Measuring the Reference Line:**
    - If necessary, use the Total Station to measure and define the reference line by setting the instrument at one end and aiming at the other end (or using existing control points).
    - Ensure the line is properly aligned and the coordinates of the line are recorded.
3. **Measuring Offsets:**
    - For each feature or point that you wish to measure an offset from, position the prism rod at that point.
    - Using the Total Station, measure the horizontal angle and distance from the instrument to the prism.
    - Move the prism along the feature to other points and repeat the angle and distance measurements.
    - Record the horizontal distance (offset) from the reference line to the feature at each measurement point.
4. **Calculation of Perpendicular Offsets:**
    - The Total Station will provide you with the perpendicular offset distance, but it can also calculate the horizontal distance using the angular and linear measurements.
    - If the Total Station does not automatically compute the perpendicular offset, use the formula:

$$\text{Offset} = \text{Distance} \times \sin(\theta)$$

where:

- Distance is the straight-line distance from the instrument to the target,
- θ is the angle between the reference line and the line of sight to the target point.

5. **Verification and Recording:**
    - After each measurement, verify the consistency and accuracy of the offset measurements.
    - Record all data, including angles, distances, and calculated offsets in your survey notebook or data recording device.

OBSERVATION:

- **Measured Horizontal Angle**: The angle between the reference line and the instrument's line of sight to the target.

- **Measured Distance**: The straight-line distance from the Total Station to the target point on the feature.
- **Offset Distance**: The perpendicular distance from the reference line to the feature at the target point.

TABULATION TABLE:

S. No.	Target Feature	Measured Horizontal Angle (°)	Measured Distance (m)	Calculated Offset (m)	Remarks

RESULT:

The offset distances from the reference line to each of the surveyed features were successfully measured. The perpendicular offsets were calculated using the angles and distances provided by the Total Station, and the measurements were consistent with the expected results. The Total Station proved to be an efficient tool for measuring offsets with high precision, and the collected data was verified for accuracy.

Expt No. 8	AREA MEASUREMENT	Date of Expt:

AIM:

To compute the area of a polygon using total station.

INSTRUMENTS REQUIRED:

1. Total station and its accessories
2. Prism(Reflector)
3. Prism pole
4. Tripod stand
5. Arrows.

FORMULA:

Cos = $a^2+b^2-c^2/2ab$

Area of = $\sqrt{s(s-a)\,(s-b)\,(s-c)}$

Where s is the semi perimeter Δ^{le} s= a+b+c/2

PROCEDURE:

- First 5 points are chosen named as A,B,C,D,E by arrows.
- The instrument is to be setup at point A. The tripod is setup and adjusted suitably such that is parallel to the ground. Now mount, the TS instrument on the tripod.
- Make sure that the batteries are placed on both sides of the instrument. Switch 'ON' the instrument and remove the styles from the holder.
- Now, centering should be done for which electromagnetic wave inform of a laser comes through the laser part of the instrument.
- Laser is made to hit the arrow for which adjustments are made, the tripod stand is adjusted suitably.
- Leveling should be done for which we need to monitor the bubble and the electronic bubble (displayed on the screen). The tripod is so adjusted. Such that the red bubble attains the centre point of the circle (concentric circle) and turns into green.
- This green color is an indicator that the bubble is centered. By doing so, we can make the angle closes to 30.Now we can start the surveying (after the preliminary adjustments).
- The distance between the centre of the telescope (indicated by + mark) and the ground is measured using a steel tape. This is the height of the instrument and given as input.
- The prism(reflection) with pole is held at point B and then, the reference measurements are set in the instruments. They are set by viewing the reference pt through the peep sight (seen in triangular shape)

- After completing the reference measurements, angles slope distances, horizontal and vertical distances. Elevation are digitally computed and displayed on the screen.
- The process involved here is that electro optic wave generated in the instrument hits the prism and travels back. As a result the distances are computed digitally.
- The same procedure is repeated for points B,C,D,E.
- These are calculated to obtain redundancy. Hence accuracy is attained.
- Finally, the area is calculated using the given formula.

DIAGRAM:

TABULATION:

HEIGHT OF INSTRUMENT = **HEIGHT OF REFLECTION =**

INST. STATION	SIGHT. TO	ELEVATION (m)	HORIZONTAL ANGLE	VERTICAL ANGLE	SLOPE DISTANCE	HORIZONTAL DISTANCE (m)	VERTICAL DIATNCE (m)

CALCULATIONS:

RESULT:

The area of the polygon as measured using total station is formed to be _______________.

Expt No. 9	TOTAL STATION TRAVERSING	Date of Expt:

AIM:

To perform a Total Station traversing exercise to establish a series of connected survey points (stations) using angular and distance measurements, and to compute the relative positions of points in a survey network.

INSTRUMENTS REQUIRED:

- **Total Station** (with accessories like tripod, prism, etc.)
- **Prism Rod** (for reflecting signals to the Total Station)
- **Measuring Tape** (for additional manual measurements, if required)
- **Reflector** (for Total Station measurements)
- **Tripod** (for mounting the Total Station)
- **Surveying Notebook** (for data recording)
- **Field Markers** (for marking survey points on the ground)
- **Leveling Instrument** (optional, for height differences between stations)

PRINCIPLE:

Total Station traversing involves measuring the angles and distances between a series of survey points, called traverse stations, to create a network. This technique is used to establish the relative positions of points and is fundamental in surveying for boundary determination, construction, and mapping.

- **Angular Measurement**: Using the Total Station, angles between successive survey lines are measured (both horizontal and vertical angles).
- **Distance Measurement**: The Total Station is used to measure the straight-line distances between survey stations, which are essential for calculating the coordinates of points.
- **Traverse Closure**: A traverse is considered closed when the final station coincides with the starting station or returns within an acceptable error range.

Traversing can be either **closed traverse** (where the starting and ending points are the same) or **open traverse** (where the starting and ending points are different, often used in long-distance surveys).

TABULATION:

S. No.	Station No.	Measured Horizontal Angle (°)	Measured Vertical Angle (°)	Measured Distance (m)	Coordinate (Easting, Northing)	Remarks

RESULT:

- The Total Station traversing was successfully completed, and the relative positions of all the surveyed points were established.
- The measurements for angles and distances were accurately recorded, and the traverse network was created.
- For the closed traverse, the final station was within an acceptable error range of the starting point, confirming the accuracy of the measurements.
- The results also confirmed the use of the Total Station for establishing a series of connected survey points with high precision.

Expt No. 10	STUDY OF HAND HELD GPS	Date of Expt:

AIM:

To study the function and working of handheld GPS (HHGPS)

DESCRIPTION:

Global positioning systems (GPS) is a satellite-based system. GPS is a device that is capable of receiving information from GPS satellites to calculate the geographical position. Using suitable software, the device may display the position on a map and it may offer directories.

A GPS device can retrieve from the GPS system location and time information in all weather conditions anywhere on or near the earth. A GPS reception requires an unobstructed line of right to four or none GPS satellite.

HHGPS receives only one frequency LI

SPECIFICATIONS:

Frequency LI – received

Accuracy: 2-5 m

Make: Trimble

Software: Terra Sync

Platform: Industry standard Windows – Mobile 6.1

High Sensitivity GPS receiver

GPS TERMINOLOGY:

1. Datum: WGS 84 (i.e.) World geodetic system-1984. It is the precise coordinate system.

2. PDOP: Position Dilution of precision.

It is an indicator quality of GPS position. Low PDOP indicate higher probability of accuracy. Generally PDOP~1.8 is more accurate. It can range between 2-3 for better accuracy.

3. Ellipsoidal height: HAE: Height about earth's surface.

It is height w.r.t the ellipsoidal shape. It was indicated with –ve sign.

4. PNR- pseudo random noise

5. SNR- signal to noise ratio

It indicates the strength of the signal. It is the measure of the information content of the signal relative to the signal's noise.

RESULT:

Hence, the working and terminologies in GPS is studied.

Expt No. 11	STUDY OF GEODETIC GPS	Date of Expt:

AIM:

To study the principles and working of Geodetic GPS (Global Positioning System) and understand its application in surveying for precise positioning and geodetic measurements. This experiment will also compare the measurements obtained using GPS with the measurements from a Total Station.

INSTRUMENTS REQUIRED:

- **Geodetic GPS Receiver** (Dual-frequency or Survey-grade GPS)
- **GPS Antenna** (For signal reception)
- **Total Station** (For comparison purposes)
- **Prism Rod** (for Total Station measurements)
- **Surveying Tripod** (for mounting the GPS receiver and Total Station)
- **Data Collector/Surveying Notebook** (for recording GPS and Total Station data)
- **Measuring Tape** (for additional manual measurements, if required)
- **Software** (For post-processing GPS data, if applicable)
- **Computer or Laptop** (for processing GPS data)
- **Field Markers** (for marking the survey points)

PRINCIPLE:

Geodetic GPS uses a network of satellites in Earth's orbit to provide precise position information. The GPS receiver calculates its position by triangulating signals received from multiple satellites. By measuring the time it takes for a signal to travel from the satellite to the GPS receiver, it can compute the distance and, ultimately, the precise location of the receiver.

In Geodetic GPS surveying, dual-frequency receivers are typically used to correct for errors caused by the ionosphere, improving accuracy. This method provides high-accuracy positioning suitable for geodetic measurements, with accuracy often down to a few millimeters.

The Total Station, on the other hand, uses a combination of angular and distance measurements to calculate the position of points on the Earth’s surface.

PROCEDURE:

1. **Setup of GPS Receiver:**
    - Mount the GPS antenna on a stable tripod or pole at the survey point.
    - Ensure the GPS receiver is connected and powered on. Connect the data collector to the GPS receiver.

- Ensure the GPS is set to record data continuously or for the desired duration (depending on the accuracy requirements).
- For dual-frequency GPS receivers, select the appropriate setting for maximum accuracy (e.g., RTK mode for real-time kinematic surveying).

2. **Setting Up the Total Station:**
    - Set up the Total Station over a known control point or survey station.
    - Ensure the Total Station is level and properly aligned using the levelling bubble.
    - Record the instrument setup position and initialize the survey.
3. **Surveying with GPS:**
    - Once the GPS receiver has acquired signals from sufficient satellites (typically 4-6), start recording the position.
    - Allow the GPS receiver to collect data for a sufficient period to ensure high accuracy (this might range from several minutes to an hour, depending on the required precision).
    - Record the geographic coordinates (latitude, longitude, and elevation) or the projected coordinates (UTM or local coordinate system) as provided by the GPS receiver.
4. **Surveying with Total Station:**
    - Use the Total Station to measure the distance and angles from the instrument to a target point (e.g., prism).
    - Record the measured angles and distances in the survey notebook or data collector.
    - Use the instrument to calculate the coordinates of the target point based on the instrument's position and the recorded measurements.
5. **Data Comparison and Post-Processing:**
    - After the GPS data collection, transfer the data to the computer and process it using appropriate software (such as Trimble Business Center or Leica Geo Office).
    - Compare the GPS coordinates with the coordinates obtained from the Total Station for the same survey point.
    - If the GPS is operating in RTK mode, the accuracy should be within a few centimeters. If not, post-processing corrections can improve accuracy.
6. **Repeat for Multiple Points:**
    - For more comprehensive results, repeat the survey for several points in the field, using both the GPS and Total Station for each point.

- Ensure that both the Total Station and GPS receiver are set up in similar conditions (e.g., same locations for control points).

OBSERVATION:

- **GPS Coordinates:** Latitude, Longitude, and Elevation (or UTM Coordinates) of the survey point.
- **Total Station Measurements:** Horizontal and vertical angles, distances, and calculated coordinates of the target point.
- **Time for GPS Data Collection:** Duration of GPS data recording for accuracy.
- **Signal Quality:** Number of satellites locked and signal strength during the GPS survey.

TABULATION TABLE:

S. No.	Survey Point	GPS Coordinates (Latitude, Longitude, Elevation)	Total Station Coordinates (Easting, Northing, Elevation)	Difference (Easting, Northing, Elevation)	Remarks

RESULT:

- The GPS and Total Station measurements for each point were compared, and the differences in coordinates were found to be minimal, demonstrating the accuracy of the Geodetic GPS system.
- The Total Station also provided accurate measurements, confirming its role as a reliable tool in field surveying.
- The experiment highlighted that Geodetic GPS provides fast and accurate positioning, particularly for geodetic and large-scale surveying applications.

Expt No. 12	STATIC AND SEMI KINEMATICS SURVEY	Date of Expt:

AIM:

To perform a static and semi-kinematic survey using a Total Station, understand the principles behind these methods, and compare the results with known reference points. This experiment will demonstrate how these surveying techniques are used to determine precise positions using angular and distance measurements.

INSTRUMENTS REQUIRED:

- **Total Station** (with accessories such as prism, tripod, etc.)
- **Prism Rod** (for reflecting signals to the Total Station)
- **Surveying Tripod** (for mounting the Total Station)
- **GPS Receiver** (optional, for reference positioning in kinematic mode)
- **Measuring Tape** (for additional manual measurements, if required)
- **Reflector** (for Total Station measurements)
- **Surveying Notebook** (for recording data)
- **Field Markers** (for marking survey points)
- **Data Recorder/Computer** (optional, for digital data collection and processing)

PRINCIPLE:

- **Static Surveying**: In static surveying, the Total Station remains stationary at one point while measuring angles and distances to a series of targets (prisms) placed at different survey points. The total station collects data over a longer period to achieve high precision. The position of each target is calculated using the measured distances (slant range) and angles (horizontal and vertical). This method is typically used in geodetic surveying and for establishing control points.
- **Semi-Kinematic Surveying**: Semi-kinematic surveying is a combination of static and kinematic surveying. In this method, the Total Station is moved between different points or stations, but each station records measurements for a shorter period (often only a few minutes). This approach provides real-time results, while still maintaining a high level of accuracy. Semi-kinematic surveys are typically used for tasks like boundary surveys or when a rapid survey is needed, but high accuracy is still desired.

PROCEDURE:

1. Static Surveying Procedure:

1. **Setup the Total Station**:
   - Choose a stable location for the Total Station setup. This will act as your reference point (control point).
   - Mount the Total Station on the tripod and level the instrument using the leveling bubble.
   - Set the known coordinates of the control point (if available) in the Total Station or record it for later use.
2. **Measure Angles and Distances**:
   - Place the prism at the survey point (target point) you want to measure.
   - Use the Total Station to measure the horizontal angle, vertical angle, and slant distance to the prism.
   - Record the data (angles and distances) in the survey notebook or data collector.
   - Repeat the process for multiple target points from the same Total Station setup.
3. **Reposition and Repeat Measurements**:
   - If necessary, move the Total Station to other points in the survey area and repeat the angle and distance measurements to different targets.
   - Record all data in the notebook.
4. **Post-Processing**:
   - Use the recorded angles and distances to calculate the coordinates of the target points using coordinate geometry formulas or a survey software.

2. Semi-Kinematic Surveying Procedure:

1. **Initial Setup**:
   - Similar to static surveying, set up the Total Station at the reference control point.
   - Ensure that the Total Station is stable and levelled properly.
2. **Measure Points with Movement**:
   - Place the prism at various survey points in the field, moving the Total Station from one point to another.
   - At each station, the Total Station will record the angles and distances to the target for a short period (e.g., 2-5 minutes).
   - Record the data and move to the next survey point.

3. **Record Movement and Data**:
    - o While moving, keep track of the Total Station's position and ensure that accurate data is recorded for each target point.
    - o Use a data collector or manual recording methods to log each survey measurement.
4. **Calculation of Positions**:
    - o Calculate the coordinates of the survey points using the collected angular and distance data from each station.

Observation:

- **Measured Angles**: Horizontal and vertical angles from the Total Station to the target.
- **Measured Distances**: The slant distance from the Total Station to the target point.
- **Survey Point Coordinates**: Calculated coordinates based on the measured angles and distances.
- **Time for Measurements**: Duration of data collection at each survey point.
- **GPS Coordinates (Optional)**: If GPS is used for reference, record the coordinates of the reference point.

TABULATION TABLE:

S. No.	Station	Measured Horizontal Angle (°)	Measured Vertical Angle (°)	Measured Distance (m)	Calculated Coordinates (Easting, Northing, Elevation)	Remarks

RESULT:

The experiment showcased the application of static and semi-kinematic surveying techniques using a Total Station. Measured angles and distances were employed to calculate the coordinates of various target points. Results indicated that both methods delivered high-precision positioning, with semi-kinematic surveying offering faster data collection while maintaining acceptable accuracy. The calculated coordinates aligned closely with expected results, showing minimal differences between the two methods within the surveyed area.

Expt No. 13	DIFFERENTIAL POSITIONING	Date of Expt:

AIM:

To determine the relative positions of various points on the ground using the principle of differential positioning with a Total Station.

INSTRUMENTS REQUIRED:

1. Total Station
2. Tripod
3. Prism with pole
4. Measuring tape
5. Field book
6. Plumb bob
7. Pen or pencil

PRINCIPLE:

Differential positioning involves measuring horizontal angles, vertical angles, and distances to determine the relative positions of points in three dimensions. A Total Station integrates an electronic theodolite and an electronic distance measurement (EDM) device, which simplifies the process of obtaining precise coordinates for points by combining angular and distance measurements.

Key concepts:

1. Horizontal angle and distance measurements help compute horizontal positions (X, Y).
2. Vertical angle and distance measurements determine the elevation (Z).
3. The relative positions are calculated using trigonometric principles.

PROCEDURE:

1. **Setting up the Total Station**:
   - Fix the Total Station on a tripod at a stable and clear station point (Station A).
   - Level the instrument using foot screws and the circular bubble level.
   - Center the instrument over the station point using a plumb bob.
2. **Orientation**:
   - Sight a reference point (Station B) and set it as 0° for horizontal angle measurement.

- Record the coordinates of Station A if known or assume arbitrary coordinates.

3. **Observation of Points**:
   - Sight the prism at the desired target point and take readings for the horizontal angle, vertical angle, and slope distance.
   - Record these observations in the field book.
4. **Repetition**:
   - Repeat the process for multiple target points to establish the relative positions of all points.
   - Ensure proper alignment and accurate recording of data.
5. **Data Entry**:
   - Enter the recorded data (horizontal angle, vertical angle, and distance) into the observation table for processing.
6. **Computation**:
   - Calculate the horizontal distance (D), relative elevations (Z), and coordinates (X, Y) using trigonometric formulas.

OBSERVATION TABLE:

Station Point	Horizontal Angle (°)	Vertical Angle (°)	Slope Distance (m)	Horizontal Distance (m)	Relative Elevation (m)	Coordinates (X, Y, Z)
A						
B						
...						

RESULT:

The relative positions of the observed points were successfully determined. The computed coordinates (X, Y, Z) for each point indicate their spatial positions in the local coordinate system.

Expt No. 14	PRECISE POSITIONING	Date of Expt:

AIM:

To determine the precise coordinates of a point or series of points by employing advanced techniques with the Total Station for accurate positioning.

INSTRUMENTS REQUIRED:

1. Total Station
2. Tripod
3. Reflecting prism with pole
4. Measuring tape
5. Plumb bob
6. Field book
7. Pen or pencil

PRINCIPLE:

Precise positioning involves accurately determining the coordinates of points (X, Y, Z) by using the Total Station's capabilities to measure horizontal angles, vertical angles, and distances. High precision is achieved through:

1. **Instrument Calibration**: Ensuring the Total Station is properly calibrated for accurate measurements.
2. **Station and Back-sight Setup**: Establishing known reference points to minimize errors.
3. **Error Elimination**: Applying corrections for systematic and random errors during measurement.

The precise positioning experiment relies on trigonometric relationships, where:

- Horizontal and vertical angles are used to compute directions and elevations.
- Slope distances are converted into horizontal and vertical components.

PROCEDURE:

1. **Setup of Total Station**:
   - Mount the Total Station on a tripod at the designated base station (Station A).
   - Center the instrument precisely over the station point using a plumb bob.
   - Level the instrument using foot screws and the circular bubble.
2. **Back-sighting for Orientation**:
   - Select a known point (Station B) as a back-sight.
   - Set the horizontal angle to 0° or the azimuth of the back-sight point.

3. **Observation of Target Points**:
   - Align the Total Station with the reflecting prism placed at the target point.
   - Measure the horizontal angle, vertical angle, and slope distance to the target.
   - Record the observations in the field book.
4. **Recheck Measurements**:
   - Reobserve angles and distances to ensure consistency.
   - Eliminate any systematic errors by repeating observations.
5. **Data Processing**:
   - Use the recorded data to calculate precise coordinates (X, Y, Z) for each observed point.
6. **Repeat for Additional Points**:
   - Move the prism to subsequent target points and repeat the procedure to determine their positions.

OBSERVATION TABLE:

Station Point	Horizontal Angle (°)	Vertical Angle (°)	Slope Distance (m)	Horizontal Distance (m)	Relative Elevation (m)	Coordinates (X, Y, Z)
A (Base)	0.00					(Known)
B						
C						
...						

RESULT:

The precise coordinates of the observed points were successfully determined using the Total Station. These positions, computed with high accuracy, can be used for surveying, mapping, and engineering applications.

Expt No. 15	GPS TRAVERSING	Date of Expt:

AIM:

To determine the coordinates of a series of points using GPS traversing, and integrate these coordinates into a Total Station survey for precise geospatial mapping.

INSTRUMENTS REQUIRED:

1. GPS Receiver (preferably dual-frequency RTK or GNSS-enabled GPS)
2. Tripod for GPS setup
3. Total Station
4. Reflecting prism with pole (for Total Station integration, if necessary)
5. Measuring tape
6. Plumb bob
7. Field book
8. Pen or pencil

PRINCIPLE:

GPS traversing involves determining the relative positions of points using satellite signals to compute latitude, longitude, and elevation (WGS84 or other datum). The method relies on measuring baselines between points and computing coordinates with high accuracy.

Key components:

1. **Base Station and Rover Setup**: A stationary base station provides corrections to a roving GPS receiver (Rover) for high accuracy.
2. **Differential GPS (DGPS)**: Differential correction improves the precision of GPS measurements, reducing positional errors.
3. **Integration with Total Station**: GPS-derived coordinates are used as a reference to calibrate and align Total Station surveys.

PROCEDURE:

1. **Setup of Base Station**:
    - Select a stable location for the GPS base station with a clear view of the sky.
    - Set up the GPS receiver on a tripod and center it precisely over the reference point.
    - Switch on the base station, configure settings, and allow it to acquire satellite signals.
2. **Setup of Rover GPS**:
    - Place the rover GPS receiver at the first point to be surveyed.
    - Ensure the receiver is levelled and centered over the target point using a plumb bob.
3. **Traversing Process**:
    - Record the position (latitude, longitude, and elevation) of the first point using the rover GPS.

- Move the rover to subsequent points along the traverse and repeat the process.

4. **Differential Corrections**:
   - Ensure the base station sends real-time corrections to the rover via radio or other communication links (RTK).
   - Validate measurements for accuracy by checking with known reference points.
5. **Integration with Total Station** (Optional):
   - Import GPS-derived coordinates into the Total Station for further detailed surveys.
   - Align the Total Station with GPS coordinates to match the local coordinate system.
6. **Data Recording**:
   - Record all measurements in the observation table, ensuring consistency and accuracy.

OBSERVATION TABLE:

Point ID	Latitude (°)	Longitude (°)	Elevation (m)	Baseline Distance (m)	Remarks
A (Base)					
B					
...					

RESULT:

The GPS traversing experiment successfully determined the coordinates of the target points. The observed positions can be used for geospatial mapping and integration with Total Station surveys for precise surveying applications.