



## Topic one: Introduction to Geodetic surveying

### 1.1 Introduction:

The early curiosity of man has driven him to learn more about the vastness of our planet and the universe. In earlier times of human development, our understanding of our whereabouts was limited. Over time, we desired to know more and to stretch further than what was in our immediate vicinity. Our world interest grew the more we speculated about our identity, ability, and the composition of our surroundings. Advances in science have allowed us to determine our exact location on Earth in terms of its shape.

Geodetic Surveying aims to describe and measure the extensive nature and actual shape of the Earth. To perform this we must use the accompanying and supportive science of geodesy. “Geodesy is understood as a branch of applied mathematics that determines by observation and measurement the exact positions of points and the figures and areas of large positions of the earth’s surface, the shape and size of the earth, and the variations of terrestrial gravity.”

**Geodesy:** is a highly specialized, applied science that uses many basic physical and mathematical components to arrive at the conclusions and understanding. Geodetic surveys produce a higher level of accuracy of true ground distances by projection onto the calculated surface by taking into account the latitude, longitude and height of a specific coordinate. Each point has a specific combined factor, but surveyors typically calculate one combined factor for a given project location dependent on the overall area that needs to be surveyed.

We can differentiate geodetic surveying from plane surveying in the simple fact that geodetic surveying accounts for the curvature of the Earth. This allows us to achieve higher precision and extend over larger project areas, while plane surveying is useful when measuring small project areas.

We understand geodesy as a science that finds positions on our planet while determining the corresponding gravitational fields. This seems as simple as knowing the shape and supportive mathematical formulas. What is important to note is that a great deal of our technology to date is dependent upon and allowed for because of geodesy and our understanding of the subject.



We can only understand components of climate change (i.e. rising sea levels) by way of geodesy and its related technology. Space exploration and our understanding of the vastness beyond our planet is only possible because of this branch of science.

## 1.2 Geodetic surveying sections:

### 1.2.1 Based on the work area or the boundaries of the geodetic measurement area:

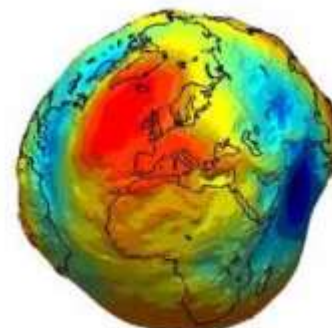
- A. Global Geodesy:** It determines the shape and size of the Earth's gravity field.
- B. National Geodetic Survey:** It is responsible for determining the shape and size of the gravity of a particular country and is done by creating networks (ground constants) with known coordinates and the value of the Earth's gravity. It takes into account the effects of the Earth's spherical.
- C. Plane Surveying:** Responsible for the detailed measurements necessary for engineering works for small areas and topographical works for producing maps.

### 1.2.2 In terms of the nature of the work:

- A. Terrestrial or engineering geodesy:** Horizontal and vertical angles and distances are measured by calculating each point's three-dimensional coordinates (x, y, z). And using the theodolite wild T2 device for ground measurements.

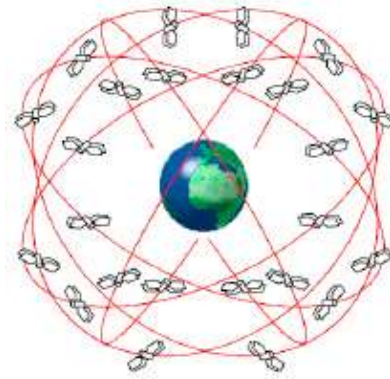


- B. Physical geodesy:** Determining the true shape of the Earth and its relationship to the geometric shape used in creating maps, using astronomical observations or satellites.

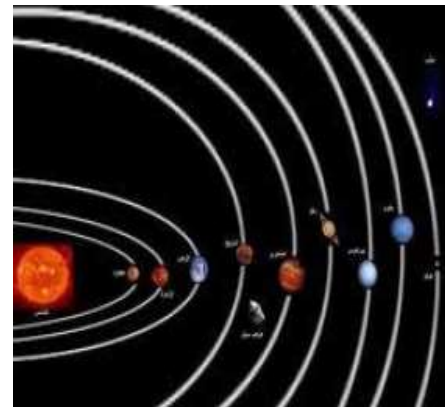




**C. Space geodesy:** relies on satellites in engineering, in addition to physical and astronomical geodesy.



**D. Astronomical geodesy:** It depends on lines of longitude and latitude, and its use has decreased since the advent of satellite applications.



**F. Mathematical Geodesy:** It relies on mathematical theories and equations and is used in all types of geodesy.

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_K \end{bmatrix} = \begin{bmatrix} X_1 & & & \\ & X_2 & & \\ & & \ddots & \\ & & & X_K \end{bmatrix} \begin{bmatrix} G_1 \\ G_2 \\ \vdots \\ G_K \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_K \\ c \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_K \end{bmatrix}$$

### 1.2.3 The purpose of the measurements:

- A. Horizontal or geodetic observations 2D:** It depends on longitudes and latitudes with the use of surveying devices (theodolite).
- B. Vertical or geodetic observations 1D:** It is a network separate from the horizontal network and depends on the differences in levels for a group of points of a single geodetic network covering the study area.
- C. Geodetic meteorology 3D:** depends on the three dimensions (x, y, z).
- D. 4D dynamic geodesy:** Monitoring the change in 3D coordinates over time (the fourth dimension), where measurements are taken at a specific time.