**6 th SEMESTER (MAJOR)**

**PAPER 604: PRINCIPLES AND APPLICATION OF REMOTE SENSING, GIS AND GPS**

**UNIT 3: GLOBAL POSITIONING SYSTEM**

**By -Rashmi Sarkar**

**Function and Working Principles of GPS:**

**Introduction:**  The term GPS full form is “Global Positioning System” which is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars, and trucks also. The system gives critical abilities to military and civilian users around the globe. GPS provides continuous real-time, 3-dimensional positioning, navigation, and timing worldwide.

**Function of GPS System:**

The GPS consists of three segments:

* The space segment: the GPS satellites
* The control system, operated by the U.S. military,
* The user segment, which includes both military and civilian users and their GPS equipment.

#### Space Segment

The space segment is the number of satellites in the constellation. It comprises 29 satellites circling the earth every 12 hours at 12,000 miles in altitude. The function of the space segment is utilized to route/navigation signals and to store and retransmit the route/navigation message sent by the control segment. These transmissions are controlled by highly stable atomic clocks on the satellites. The GPS Space Segment is formed by a satellite constellation with enough satellites to ensure that the users will have, at least, 4 simultaneous satellites in view from any point at the Earth’s surface at any time.

#### Control Segment

The control segment comprises a master control station and five monitor stations outfitted with atomic clocks that are spread around the globe. The five monitor stations monitor the GPS satellite signals and then send that qualified information to the master control station where abnormalities are revised and sent back to the GPS satellites through ground [antennas](https://www.elprocus.com/different-types-of-antennas-with-properties-and-thier-working/). The control segment also referred to as a monitor station.

#### User Segment

The user segment comprises the GPS receiver, which receives the signals from the GPS satellites and determines how far away it is from each satellite. Mainly this segment is used for the U.S military, missile guidance systems, civilian applications for GPS in almost every field. Most of the civilians use this from survey to transportation to natural resources and from there to agriculture purpose and mapping too.

**Working of GPS system:**

1. **MILITARY USES FOR GPS:**

The system made its public debut to rave reviews in the 1991 Gulf War. U.S. troops used it for navigation on land, sea, and in the air, for targeting of bombs, and for on-board missile guidance. GPS allowed U.S. ground troops to move swiftly and accurately through the vast, featureless desert of the Arabian Peninsula. GPS receivers were used in several aircraft, including F-16 fighters, KC-135 aerial refuelers, and B-2 bombers Navy ships used them for rendezvous, minesweeping, and aircraft operations. GPS has become important for nearly all military operations and weapons systems. In addition, it is used on satellites to obtain highly accurate orbit data and to control spacecraft orientation.

1. **GPS USES IN EVERYDAY LIFE**

The GPS system was developed to meet military needs of the Department of Defense, but new ways to use its capabilities are continually being found. Today, GPS is saving lives, helping society in many other ways.

1. **Aircraft, Shipping and Automobile navigation**

Airlines have saved millions of dollars by using GPS to hone their flight plans. GPS can be used for instrument landing at small, as well as large, airports and is making new air-avoidance systems possible. GPS not only makes flying safer, but also more efficient. And GPS saves fuel and extends an aircraft`s range by ensuring pilots don`t stray from the most direct routes to their destinations. GPS accuracy will also allow closer aircraft separations on more direct routes, which in turn means more planes can occupy our limited airspace. Shipping companies equip their tankers and freighters with GPS for navigation and to record and control the movement of their-vessels. Automobile manufacturers are offering moving-map displays guided by GPS receivers as an option on new vehicles so that drivers not only can find out where they are but also can be given directions on display screens. In Japan, 500,000 automobiles have already been equipped with a GPS-based navigation system.

1. **Transportation and Emergency:**

Vehicle tracking is one of the fastest-growing GPS applications. GPS-equipped fleet vehicles, public transportation systems, delivery trucks, and courier services use receivers to monitor their locations at all times and to speed deliveries. GPS is also helping to save lives. any police, fire, and emergency medical service units are using GPS receivers to determine the police car, fire truck, or ambulance nearest to an emergency, enabling the quickest possible response in life-or-death situations. And they use GPS to pinpoint destinations and map their routes.

1. **Mapping**

Mapping is the art and science of using GPS to locate items, then create maps and models of everything in the world. Because it is not affected by force of gravity, GPS can be used to draw map accurately. And GPS is applied to many kinds of measurement. because it can grasp a wide region quickly and exactly.

1. **Surveying**

In the field of wildlife management, threatened species such as the Mojave Desert tortoise are being fitted with GPS receivers and tiny transmitters to help determine population patterns and possible sources of disease. GPS-equipped balloons are monitoring goles in the ozone layer over the polar regions, and air quality is being monitored using GPS receivers. Buoys tracking major oil spills transmit data using GPS. Also, earth scientists use GPS to monitor earthquakes and the shifting of the earth`s tectonic plates. And GPS can help recoverer from the effects of the earthquake. And Satellite builders use GPS receivers to track the positions of their satellites.

1. **Clocks for computer time synchronization**

GPS is also used to disseminate precise time, time intervals, and frequency. Knowing that a group of timed events is perfectly synchronized is very important. GPS makes the job of "synchronizing our watches" easy and reliable. Telecommunications companies increasingly rely on GPS to synchronize their land-based digital networks, comparing their reference clocks directly with GPS time.

1. **Construction**

During construction of the tunnel under the English Channel, British and French crews started digging from opposite ends: one from Dover, England, one from Calais, France. They relied on GPS receivers outside the tunnel to check their positions along the way and to make sure they met exactly in the middle. Otherwise, the tunnel might have been crooked. Using GPS, construction workers can accurately measure and align. It is now possible to accurately measure any point in three dimensions anywhere on the site. So GPS allow surveyors to easily stakeout designs of roads, bridges and tunnels.

1. **Agriculture**

GPS farming systems provide precise guidance for field operations, or collection of map data on tillage, applications, planting, weeds, insect and disease infestations, cultivation and irrigation. Machine Control systems automate equipment to save time and costs associated with field operators. Field data can be used to analyze management practices and determine optimal strategies for infield operations. For example, a farming GIS database might include layers on field topograpy, soil types, surface drainage, subsurface drainage, soil testing results, rainfall, irrigation, chemical application rates, and corp yield.

8. And so forth - general leisure ( mountaineering, fishing ), management of forest

**CONCLUSION :**

The future of GPS appears to be virtually unlimited. Technological fantasies abound. The system provides a novel, unique, and instantly available address for every square yard on the surface of the planet--a new international standard for locations and distances. To the computers of the world, at least, our locations may be defined not by a street address, a city, and a state, but by a longitude and a latitude. With the GPS location of services stored with phone numbers in computerized "yellow pages," the search for a local restaurant of the nearest gas station in any city, town, or suburb will be completed in an instant. With GPS, the world has been given a technology of unbounded promise, born in the laboratories of scientists who were motivated by their own curiosity to probe the nature of the universe and our world, and built on the fruits of publicly supported basic research.