R. C. Patel College of Engineering & Polytechnic, Shirpur

Department of Civil Engineering

Name of Subject: - **ADVANCED SURVEYING (ASU)**

Course Code: - **313321**

Scheme:- **CE-3K**

Semester:- **Third**

Unit No. 04 - Remote sensing, GPS and GIS

CO4 - Locate the co-ordinates of a given stations using the relevant technology.

Unit	Title	COs	Learning hours	R Level	U Level	A Level	Total Marks
IV	Remote sensing, GPS and GIS	CO4	09	04	04	06	14

THEORY SYLLABUS CONTENT

Unit - IV Remote sensing, GPS and GIS

4.1 Remote Sensing: Definition, Electro-Magnetic Energy, Active and Passive system, Applications of remote sensing in Mining, land use / Land cover, mapping, disaster management and Environment.

4.2 Global Positioning System: Introduction, Construction and use of Global Positioning System (G.P.S.)

4.3 Geographic Information System (GIS): Overview, Component, Sources of errors, applications, Software's in GIS.

Subject Incharge
Mr. D. B. Wagh

Unit No. 04

Remote Sensing, GPS & GIS

* Remote sensing

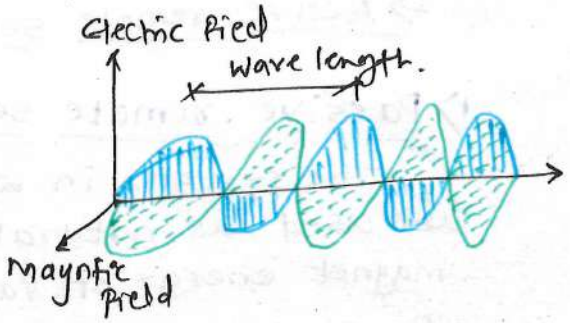
Definition:- Remote sensing is the science of acquiring information about the earth's surface without actually being in contact with it.
This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information.

* Electromagnetic Energy :-

1) Electro-magnetic energy is the energy that travels in the form of electromagnetic waves.

2) Remote sensing depends on electromagnetic energy because sensors detect and record this energy reflected or emitted from object

3) It has two field :-
   a) Electrical field
   b) Magnetic field
Both are orthogonal to each other



4) Em energy travels in waves and is characterized by Wavelength (λ) and frequency.

5) Key regions used in remote sensing are.

Region	Wavelength	Used
1. Visible	→ 0.4 to 0.7 μm	→ Natural colour imaging
2. Near Infrared (NIR)	→ 0.7 to 1.3 μm	→ Vegetation health (NDVI)
3. Short-Wave IR (SWIR)	→ 1.3 to 3 μm	→ Mineral mapping, soil moisture
4. Thermal IR	→ 3 to 14	→ Surface temperature, geology
5. Microwave / RADAR	→ 1 mm to 1 m	→ Cloud penetration, SAR imaging

* Remote sensing system :- (principle)

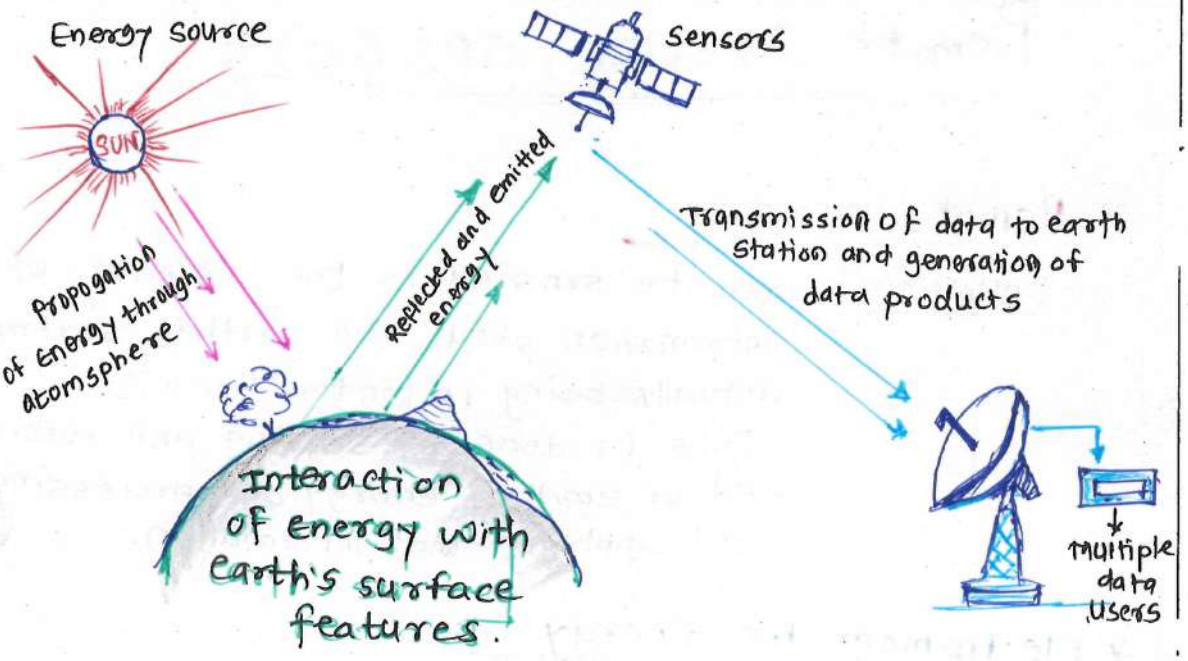


fig. Remote sensing system

* classification of Remote sensing :-

1) Passive remote sensing
2) Active remote sensing

1) Passive remote sensing :→

The system in which sun and earths materials are used as natural sources so as to radiate electro magnet energy of variable wavelength is called as Passive system.

It is rely on natural energy - primiarily reflected sunlight or emitted thermal radiation. they can only operate in daylight (visible/NIR) or when the surface emits heat. (Examples : Landset, SPOT ...)

2) Active remote sensing :-

When the system in which generate and trasmits its own artificial Electromagnetic sources such as RADAR, is used then it is called as Active system.

If generate and transmit their own energy, then record

the signal that bounces back from the target. key Advantages: all weather operation, day and night capability (Example: RADAR (SAR), LiDAR, altimeters)

Application of Remote Sensing

1) Mining :-

a) Remote sensing used in lithological and structural mapping, identifying mineralization zones through anomalous spectral signatures in SWIR and thermal bands.

b) applicable in mineral exploration, mine planning, monitoring and detection of illegal mining.

2) Land used (or) Land cover analysis :-

a) Remote sensing technique are useful for taking images of large area quickly, and it is cheaper than ground surveying

b) Identifying of agricultural land, forest mapping, urban area mapping & water body mapping.

3) Mapping :-

a) High-resolution stereo imagery enables generation of Digital Elevation models (DEMs) and topographic maps.

b) Uses- Topographical maps, Road maps, city maps & Land records

4) Disaster Management :-

a) SAR (Synthetic Aperture Radar) can penetrate clouds and darkness to map flood extents within hours of an event.

b) MODIS and thermal sensors track wildfire spread; optical imagery assesses earthquake and cyclone damage for rapid response and relief planning

c) Uses - flood monitoring, Earthquake assessment, Cyclone tracking Landslide detection & forest fire monitoring.

5) Environment :-

a) Remote sensing monitors water quality (turbidity, algal blooms), tracks glacier retreat, quantifies soil erosion and free global coverage for environmental monitoring.

b) Uses .. pollution monitoring, climate change studies, water resource management, coastal zone management.

* Global Positioning System (G.P.S.) :-

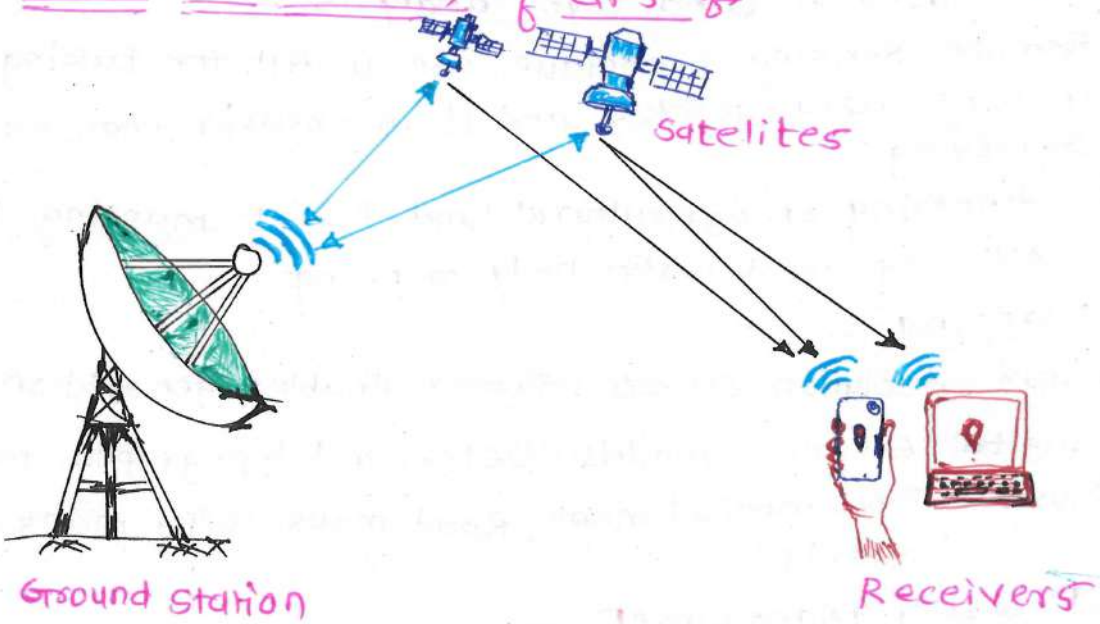
Definition :-

GPS is satellite navigation system used to determine the ground position of an object

OR

GPS is a satelite-based radio navigation system that Provides exact location, time, and velocity information anywhere on earth, regardless of weather conditions. It lets users know where they are and where the're going.

Basic construction of GPS :-



GPS is constructed from three main parts or components, called segments :-

1) Ground control station
2) Satellites
3) Receivers

1) Ground control station (or) control segment :-

Ground control stations that track the satellites, correct their clocks and orbits, and send updated data back to them.

2) Satellites (or) space segment

Group of GPS satellites orbiting the earth that continuously transmit singnals with their position and time.

3) GPS Receivers or User segment

All GPS receivers devices (like mobiles, car GPS, survey instruments) that receive satelite signals and calculate the user's position and time.

* Use of GPS ! / Applications of GPS

1) To determine position or locations.
2) To navigate from one location to another.
3) To create digitized map.
4) To determine distance between two points
5) Used in remote sensing
6) Used in military and space
7) To track or monitor object or personal movement
8) To locate geographical features.
9) mapping, Timing, Tracking, & Navigation.

* Softwares used for GPS.

1) GPS WOX
2) iGO
3) HERE
4) Navigon
5) Navman
6) Easy GPS
7) Caliper
8) Samsarq
9) Quartix
10) clockshark
11) Tracear

Geographic Information System (GIS)

Definition :- GIS is a system that collects, displays, manages and analyzes geographic information.

(or)

GIS is a computer-based system used to capture, store, manage, analyze, and visualize geographic or spatial data.

→ It connects location data (where things are) with descriptive information (what things are like), enabling users to identify patterns, relationships, and trends.

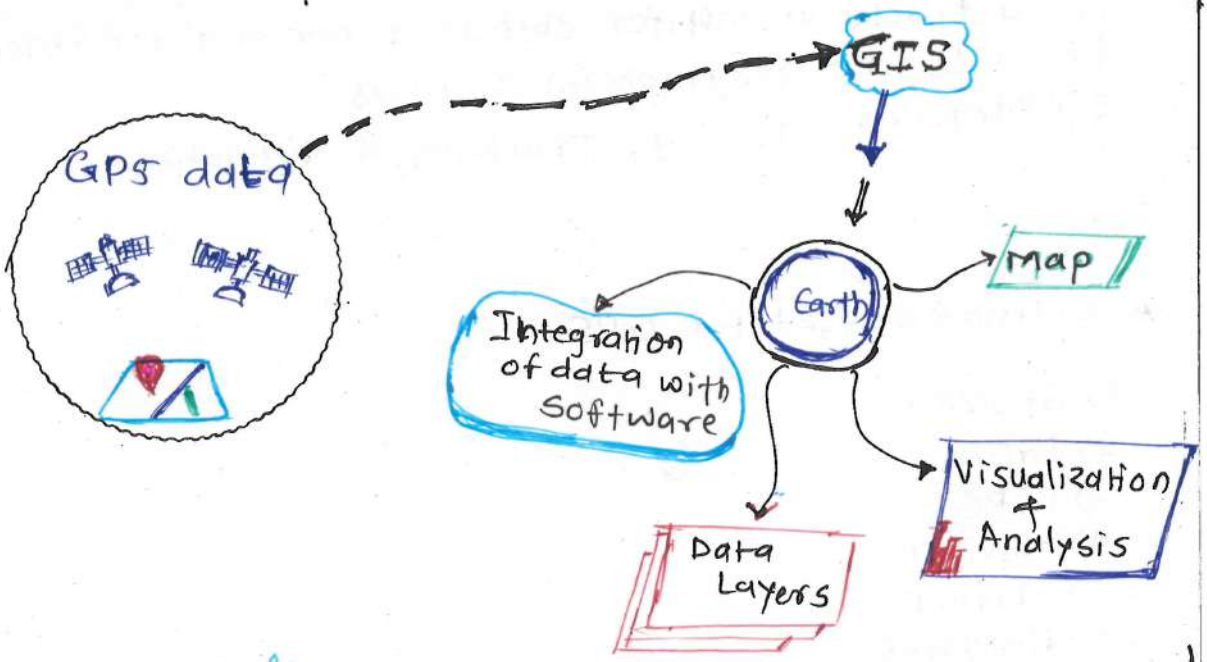


fig. GIS Structure

* Components of GIS :-

1) Hardware
2) Software
3) Data
4) People

1) Hardware :-

Physical devices like computers, servers, scanners and GPS units used to run GIS and handle spatial data.

2) Software :->

programs like ArcGIS and QGIS that are used to input, store, analyze and display geographic data as maps.

3) Data :-

The core information of GIS, including spatial data (location) and attribute data (descriptions) about features.

4) People :-

The users analysis and experts who operates GIS, design systems and use it to solve real-world problems

* Source of Error in GIS :-

Following are the various source of errors in GIS :-

1) Error due to source data :
   a) Geometrical and semantic errors in the compilation of the source map.
   b) Inaccuracy in source data.
   c) Inaccuracies due to the range character of natural boundaries.
   d) Errors due to source data being out of data
   e) Limitation of survey equipment.

2) Error occuring due to data input :-
   a) Error in attribute data entry.
   b) Errors due to operation mistakes.

3) Errors in data storage :-
   a) Error due to limited precision with which co-ordinates and other numerical data are stored.
   b) Error arising from resterization.

4) Error in data analysis and manipulation :-
   a) Error due to incorrect formula used.
   b) Error due to map overlay.

5) Error in output application :-
   a) Error due to the limitation of output device
   b) Incorrect application of GIS products.

* Application of GIS :-

⇒ Applications of GIS in Civil Engineering :-

1) Map making
2) Site selection.
3) Mineral Exploration
4) Land use planning and management
5) Environmental Impact studies
6) Natural Hazard mapping or assessment
7) Water Resources availability.

⇒ Application of GIS in various field

1) Agriculture
2) Foresty
3) Land use and soils
4) Geology
5) Urban land use
6) Environment
7) Water resource
8) Disaster.

* Softwares for GIS :-

1) ARC/INFO GIS - [to automate, manipulate, analyze and display geographic data in digital form is developed by ESRI, California]
2) PAMAP GIS :- [It uses vector data capture and storage and rosters for analysis purposes]
3) SPANS :- [having powerful modelling fuction for application]
4) GENAMP :- [handle data in both vector and raster form]
5) INTEGRAPH MGE :- [MGE - modular GIS Environment as a solution for mapping/GIS application for infrastructure, environmental & natural resources management & digital cartograph]
6) Q GIS (Quantum GIS)
7) GRASS GIS
8) SAGA GIS
9) GeoDa
10) Whitebox GAT

Important Questions

1) Define active system and passive system. (W-23, W-24)

2) Define electromagnetic energy (W-24)

3) Name any two software for GIS (S-25)

4) Define term 'Remote sensing' (W-25) (S-25)

5) Define following terms and give any two components of each -
   (I) GIS
   (II) GPS (W-25, S-25)

6) Explain any four applications of remote sensing in civil Engineering. (W-25, S-24, S-23)

7) Compare Active and passive system of remote sensing with three points (W-23)

8) Explain any four applications of GIS (W-25) (W-24)

9) Write sources of errors in GIS (W-23) (S-25)

10) State the different GPS receiver errors

11) Explain with sketch principle of remote sensing

12) State the object of remote sensing (W-24)

13) Explain construction of GPS

14) What is GIS

15) Define → i) GIS ii) GPS (W-25, S-25)