D.N.R.COLLEGE(AUTONOMOUS), BHIMAVARAM

DEPARTMENT OF GEOGRAPHY

INTRODUCTION TO REMOTE SENSING AND GIS

E- CONTENT

K.SOMAYYA

LECTURER IN GEOGRAPHY

UNIT I: Introduction to Remote Sensing

Definition and Basis of Remote Sensing:

- **Remote Sensing:** The science of obtaining information about objects or areas from a distance, typically from aircraft or satellites.
- **Principles:** Involves the detection and measurement of radiation of different wavelengths reflected or emitted from distant objects or materials.

Electromagnetic Spectrum:

- **Overview:** The range of all types of EM radiation.
- **Visible Light:** Part of the spectrum that is visible to the human eye (approximately 400-700 nm).
- **Infrared (IR):** Includes near-infrared (700-1400 nm) and thermal infrared (3-14 μm).
- **Microwave:** Ranges from 1 mm to 1 m wavelengths, used in radar remote sensing.

Stages in Remote Sensing:

1. **Energy Source or Illumination:** Provides electromagnetic energy to the target.
2. **Radiation and the Atmosphere:** Interaction of EM radiation with the atmosphere.

3. **Interaction with the Target:** How the energy interacts with the Earth's surface.
4. **Recording of Energy:** Sensors capture the reflected or emitted energy.
5. **Transmission, Reception, and Processing:** Data is transmitted to receiving stations and processed into images.
6. **Interpretation and Analysis:** Extracting meaningful information from the processed images.
7. **Application:** Applying the data for practical uses such as environmental monitoring, urban planning, etc.

Platforms of Remote Sensing:

- **Ground-Based Platforms:** Cameras and sensors mounted on ground vehicles or structures.
- **Airborne Platforms:** Aircraft, drones, and balloons.
- **Spaceborne Platforms:** Satellites orbiting the Earth.

Types of Satellites:

- **Geostationary Satellites:** Remain stationary relative to a fixed point on Earth.
- **Polar-Orbiting Satellites:** Move over the poles, providing global coverage as the Earth rotates.
- **Sun-Synchronous Satellites:** Pass over the same part of the Earth at the same local solar time.

Types of Sensors:

- **Passive Sensors:** Detect natural energy (e.g., sunlight) that is reflected or emitted by objects.
- **Active Sensors:** Emit their own signal and measure the reflected energy (e.g., radar, lidar).

UNIT II: Aerial Photographs and Remote Sensing in India

Introduction to Aerial Photographs:

- **Advantages:**
  - Provide a bird's-eye view of the area.
  - High spatial resolution.
  - Useful for creating detailed maps and models.
- **Types:**
  - **Vertical Photographs:** Camera axis perpendicular to the ground.
  - **Oblique Photographs:** Camera axis inclined at an angle.

Remote Sensing in India Development:

- **ISRO (Indian Space Research Organisation):** Leading agency for space research and remote sensing in India.
- **Key Programs:**
  - **IRS (Indian Remote Sensing) Satellites:** Series of Earth observation satellites.
  - **Cartosat Series:** High-resolution imaging satellites for cartography.
  - **Resourcesat Series:** Satellites for resource monitoring.

Applications of Remote Sensing Techniques in Geographical Aspects:

- **Agriculture:** Crop monitoring, soil mapping, and precision farming.
- **Forestry:** Deforestation monitoring, forest health assessment.
- **Urban Planning:** Land use mapping, infrastructure development.
- **Disaster Management:** Flood mapping, earthquake impact analysis.
- **Water Resources:** Hydrology, watershed management.

UNIT III: Introduction to Geographical Information Systems (GIS)

Definition, Purpose, and Advantages:

- **GIS:** A system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.
- **Purpose:** To provide a framework for gathering and organizing spatial data and related information.
- **Advantages:**
    - Efficient data management.
    - Improved decision-making.
    - Enhanced communication through maps and reports.
    - Cost savings from greater efficiency.

History of GIS:

- **1960s:** Early development with computer mapping and spatial analysis.
- **1980s:** Advent of commercial GIS software.
- **1990s:** Integration with other technologies, widespread adoption.

Software and Hardware Requirements:

- **Software:**
  - **Desktop GIS:** e.g., ArcGIS, QGIS.
  - **Web GIS:** e.g., Google Earth, MapServer.
- **Hardware:**
  - **Computers:** High-performance PCs or servers.
  - **Storage Devices:** For large datasets.
  - **Input Devices:** Scanners, GPS units.
  - **Output Devices:** Printers, plotters.

Classification of Software and Hardware:

- **Software:**
  - **Proprietary Software:** Commercially available, e.g., ArcGIS.
  - **Open-Source Software:** Free to use and modify, e.g., QGIS.
- **Hardware:**
  - **Workstations:** High processing power for complex analyses.

- **Servers:** For storing and managing large spatial databases.

UNIT IV: GIS Data Types

Spatial and Attribute Data:

- **Spatial Data:** Information about the location and shape of geographic features.
- **Attribute Data:** Descriptive information about spatial features (e.g., population, land use).

Raster and Vector Data Structure:

- **Raster Data:**
  - **Definition:** Grid-based data represented by cells or pixels.
  - **Examples:** Satellite images, digital elevation models.
- **Vector Data:**
  - **Definition:** Data represented by points, lines, and polygons.
  - **Examples:** Maps of roads, boundaries, and buildings.

GPS/DGPS:

- **GPS (Global Positioning System):** Satellite-based navigation system providing location and time information.
- **DGPS (Differential GPS):** Enhanced GPS with higher accuracy using reference stations.

- **GNSS (Global Navigation Satellite System):** General term for satellite navigation systems, including GPS, GLONASS, Galileo, and Beidou.

Applications of GPS:

- **Navigation:** Personal and vehicular navigation.
- **Surveying:** Accurate location data for mapping and construction.
- **Geotagging:** Adding location information to photos and social media posts.
- **Disaster Management:** Locating and managing resources during emergencies.

UNIT V: Remote Sensing and GIS Integration

Integration:

- **Concept:** Combining remote sensing data with GIS for comprehensive spatial analysis.
- **Process:** Involves data collection, processing, analysis, and visualization.

Applications of GIS in Various Fields of Geography:

- **Environmental Management:** Monitoring environmental changes, managing natural resources.
- **Urban Planning:** Land use planning, infrastructure development.

- **Agriculture:** Precision farming, crop monitoring.
- **Forestry:** Forest inventory, deforestation analysis.
- **Disaster Management:** Risk assessment, emergency response planning.
- **Transportation:** Route optimization, traffic management.