

Unit 1

Chapter 1 : Remote Sensing

1-1 to 1-20

Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning.

1.1	Definition and scope of Remote Sensing	1-1
1.2	History and Development of Remote Sensing Technology	1-2
	1.2.1 History and Development of Remote Sensing Technology across the world	1-2
	1.2.2 Evolution of satellite Remote Sensing in India.....	1-3
1.3	Principles of Remote Sensing	1-3
1.4	Components of Remote Sensing.....	1-4
1.5	Electromagnetic Radiation (EMR).....	1-5
	1.5.1 Characteristics as Wave Motion.....	1-6
	1.5.2 Characteristics as Particle Motion	1-6
1.6	Electromagnetic Spectrum	1-7
1.7	Atmospheric Window	1-8
1.8	Remote Sensing Platforms.....	1-10
	1.8.1 Ground-Based Platforms.....	1-11
	1.8.2 Aerial Platforms	1-12
	1.8.3 Satellite Platforms.....	1-12
1.9	Elements of RS for Visual Interpretation.....	1-12
1.10	Applications of Remote Sensing in Civil Engineering/town Planning	1-19

Unit 2

Chapter 2 : Remote Sensing Satellites and Sensor Characteristics

2-1 to 2-32

Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image interpretation, image interpretation.

2.1	Types of Remote Sensing Satellites.....	2-2
	2.1.1 Types of the satellite.....	2-3



2.2	Characteristics of Remote Sensing Satellites.....	2-4
2.3	Types of Sensors.....	2-4
2.3.1	Sensors based on Energy Source.....	2-5
2.3.2	Sensors Based on Type of Output.....	2-5
2.3.3	Sensors Based on Type of Image.....	2-5
2.3.4	Based on Number of Bands used.....	2-6
2.4	Orbital and Sensor Characteristics of Major Earth Resource Satellites.....	2-6
2.4.1	Characteristics of Satellite Orbits.....	2-7
2.5	Characteristics of Sensor.....	2-9
2.6	Indian Remote Sensing Satellite Programs.....	2-10
2.6.1	Indian Space Programmes.....	2-11
2.7	Introduction to various Open-Source Satellite Data Portals.....	2-13
2.8	Global Satellite Programs.....	2-17
2.8.1	Landsat.....	2-17
2.8.2	SPOT.....	2-17
2.8.3	RADARSAT.....	2-18
2.8.4	European Remote Sensing Satellites.....	2-20
2.8.5	Japanese Earth Resource Satellites.....	2-20
2.9	Sensor Classification.....	2-21
2.10	Applications of Sensor.....	2-22
2.11	Some Basic Concepts and Principles.....	2-23
2.12	Introduction to Resolutions of Remote Sensing.....	2-25
2.12.1	Spatial Resolution.....	2-25
2.12.2	Spectral Resolution.....	2-26
2.12.3	Temporal Resolution.....	2-27
2.12.4	Radiometric Resolution.....	2-28
2.12.5	Visual Image Interpretation.....	2-28
2.13	Image Interpretation.....	2-29

Unit 3

Chapter 3 : GPS and GNSS

3-1 to 3-20

Introduction to GNSS and Types, IRNSS, GPS, GPS components, Differential GPS, Types of GPS tracking, application of GNSS in surveying, mapping and navigation.

3.1	Introduction to GNSS.....	3-1
3.2	Basics of GNSS	3-1
	3.2.1 History of GNSS	3-2
	3.2.2 Need of GNSS.....	3-3
3.3	GNSS Classification.....	3-4
	3.3.1 Types of GNSS	3-5
	3.3.2 Comparison of Different GNSS Systems	3-6
3.4	Components of GNSS.....	3-7
3.5	IRNSS	3-7
	3.5.1 Architecture of IRNSS.....	3-8
	3.5.2 Applications of IRNSS.....	3-9
3.6	Global Positioning Systems (GPS)	3-10
	3.6.1 Advantages and Disadvantages of GPS	3-11
3.7	Components of GPS.....	3-12
3.8	Differential GPS.....	3-13
	3.8.1 Accuracy of DGPS	3-15
	3.8.2 Sources of Errors of DGPS	3-15
3.9	Types of GPS Tracking.....	3-16
3.10	Applications of GNSS	3-17

Unit 4

Chapter 4 : Image Processing and Analysis

4-1 to 4-33

Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised and unsupervised). Digital elevation model (DEM) and its derivatives, Triangular Irregular Network Model (TIN) and other models and their applications.

4.1	Image Processing.....	4-1
4.1.1	Need of Image Processing.....	4-2



4.1.2	Steps in Image Processing.....	4-2
4.2	Digital Image.....	4-3
4.2.1	Multilayer Image.....	4-4
4.2.2	Multispectral Image.....	4-5
4.2.3	Super Spectral Image.....	4-5
4.2.4	Hyper spectral Image.....	4-5
4.3	Visual Image Interpretation.....	4-6
4.3.1	Image Interpretation Procedure.....	4-8
4.3.2	Elements of Visual Image Interpretation.....	4-8
4.4	Interpretation Keys.....	4-15
4.5	Spectral Signatures Curve.....	4-17
4.6	Digital Image Processing.....	4-17
4.6.1	Pre-processing of Digital Image.....	4-19
4.6.2	Post-processing of Digital Image.....	4-19
4.6.3	Image Enhancement.....	4-20
4.6.4	Image Transformation.....	4-21
4.6.5	Digital Image Classification.....	4-21
4.7	Image Registration.....	4-23
4.7.1	Image Registration Process.....	4-24
4.8	Digital Elevation Model (DEM).....	4-26
4.8.1	Different Sources of Elevation Data.....	4-27
4.8.2	Application of Digital Elevation Model.....	4-28
4.9	Triangular Irregular Network Model (TIN).....	4-29
4.9.1	Applications of Triangular Irregular Networks (TIN).....	4-29
4.10	Digital Surface Model (DSM).....	4-30
4.10.1	Applications of Digital Surface Model (DSM).....	4-31
4.11	Digital Terrain Model (DTM).....	4-31
4.11.1	Applications of Digital Terrain Model.....	4-32

Unit 5

Chapter 5 : Fundamentals of GIS

5-1 to 5-26

Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types and applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, thematic layers and layer combinations, difference between drafting software's and GIS, fundamentals of cartography and map design, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.

5.1	Introduction to Geographic Information System.....	5-1
5.2	Various Definitions of GIS	5-5
5.3	Spatial and Non-Spatial Data	5-6
5.3.1	Types of Database	5-8
5.4	Functions of GIS.....	5-9
5.4.1	Data Input.....	5-10
5.4.2	Data Storage and Retrieval	5-11
5.4.3	Data Transformation and Analysis.....	5-11
5.4.4	Data Output.....	5-11
5.5	Introduction to cloud computing (Types and Applications)	5-12
5.5.1	Concept of Cloud.....	5-12
5.5.2	Concept of GIS Cloud.....	5-13
5.5.3	Applications of GIS Cloud.....	5-14
5.6	Advantages of GIS.....	5-15
5.7	Essential elements of GIS.....	5-16
5.7.1	Hardware	5-16
5.7.2	Software	5-17
5.7.3	Data	5-18
5.7.4	People.....	5-19
5.7.5	Methods.....	5-20
5.8	Thematic Layers and Layer Combinations	5-20



5.9	Difference between Drafting Software's and GIS.....	5-21
5.9.1	Land Information System(LIS).....	5-22
5.9.2	Automated Mapping and Facility Management (AM/FM).....	5-22
5.9.3	GIS-T.....	5-22
5.10	Applications of RS and GIS.....	5-23
5.10.1	Applications of GIS in Civil Engineering.....	5-23
5.10.2	Applications of GIS in Hydrogeology.....	5-24
5.10.3	Applications of GIS in Geology.....	5-24
5.10.4	Applications of GIS in Surveying and Mapping.....	5-25
5.11	Fundamentals of Cartography and Map Design.....	5-25
5.11.1	Traditional Cartography.....	5-25
5.11.2	Computer Cartography.....	5-25

Unit 6

Chapter 6 : GIS Data and Applications

6-1 to 6-52

GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies : demarcation of dam catchment and command area, application in reservoir sediment analysis, application in land measurement work for land record department, applications of land use and land cover pattern, application in urban planning, applications in irrigation planning and scheduling, application in smart cities planning and development.

6.1	Introduction.....	6-1
6.2	GIS data Types.....	6-2
6.2.1	Spatial Data.....	6-2
6.2.2	Attribute Data.....	6-3
6.3	Data Representation.....	6-4
6.3.1	Nominal Variables.....	6-4
6.3.2	Ordinal Variables.....	6-4
6.3.3	Internal Variables.....	6-5
6.3.4	Ratio Variables.....	6-5
6.4	Data Acquisition.....	6-5
6.4.1	Terrain Data from Satellite Remote Sensing.....	6-6



6.4.2	Terrain from Existing Maps	6-6
6.4.3	Terrain Data Collection by Photogrammetry	6-7
6.4.4	Terrain Data from Field Surveying Methods.....	6-8
6.4.5	Digital Terrain Data by GPS	6-8
6.4.6	Digital Terrain Data from Internet/World Wide Web	6-8
6.4.7	Attribute Data Tagging	6-9
6.5	Geo-Referencing of GIS Data	6-9
6.5.1	Geographic Coordinate System.....	6-10
6.5.2	Rectangular Coordinate System	6-11
6.5.3	Non-Coordinate System	6-12
6.6	Projection Systems in GIS.....	6-13
6.7	Different Map Projections.....	6-14
6.7.1	Map Projection According to the Development of Surface	6-14
6.7.2	Map Projection According to the Method of Deviation (Source of Light)	6-18
6.8	Spatial Data Models.....	6-18
6.8.1	Vector Data Models	6-19
6.8.2	Raster Data Models.....	6-22
6.8.3	Image Data	6-25
6.9	Conversion of Raster and Vector	6-26
6.9.1	Rasterization	6-26
6.9.2	Vectorization	6-27
6.10	Attribute Data Models and its Types.....	6-28
6.10.1	Tabular Model.....	6-29
6.10.2	Hierarchical Model	6-29
6.10.3	Network Model.....	6-30
6.10.4	Relational Model.....	6-30
6.10.5	Object-Oriented Model.....	6-32
6.11	Remote Sensing Data in GIS	6-33
6.12	GIS Database and Database Management System	6-35
6.12.1	GIS Database.....	6-35
6.12.2	Database Management System	6-37
6.12.3	Choosing the most Appropriate Database Structure.....	6-42
6.13	Application of GIS	6-43
6.13.1	Application of GIS in Environmental Fields.....	6-43



6.13.2	Application of GIS in Forestry.....	6-44
6.13.3	Application of GIS in Hydrology.....	6-44
6.13.4	Application of GIS in Military.....	6-45
6.13.5	Application of GIS in Health Management.....	6-45
6.13.6	Application of GIS in Geology.....	6-45
6.13.7	Application of GIS in Land Information.....	6-46
6.13.8	Application of GIS in Civil Engineering.....	6-46
6.14	Application of GIS - Case Studies.....	6-47

□□□