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LATEST
2021-22
EDITION

REMOTE SENSING AND GIS

Civil Engineering (Professional Elective-III)
and (Open Elective-II)
B.Tech (R18) (JNTU - HYDERABAD)

B.Tech : **IV-Year I-Sem**
Prepared by : **SIA Team of Experts**
Total Pages : **144**

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ENLIGHTENING LIVES THROUGH EDUCATION

REMOTE SENSING AND GIS

B.Tech. IV-Year I-Sem Civil Engineering (Professional Elective-III) and (Open Elective-II)
JNTU - Hyderabad

CONTENTS

INTRODUCTION TO THE SUBJECT

The geographic information system is a computer based technology that is fundamentally used to store, manage and display 3-dimensional geospatial data. It is the same technology that works behind the various global positioning systems (GPS). GIS technology is used in day to day life such as in in-vehicle navigation system, GPS applications that serve different purposes and in other similar casual needs. However, apart from these, GIS finds comprehensive applications in number of science and technical fields. Some of the important applications of GIS include: mapping, natural resource management, wild life habitat analysis, riparian zone monitoring, natural hazard assessment, homeland security, etc.

In context of civil engineering, surveying is one of the major contributing factors in the advancement of GIS. Other civil engineering domains where GIS is widely used are : Transportation engineering, remote sensing, environmental engineering, advanced computer aided structural design applications, etc. This subject mainly focusses on the concepts and principles involved in the use and working of geographic information systems in order to help civil engineers understand its significance and applications in civil engineering.

The table below illustrates the complete idea about the subject, which will be helpful to plan and score good marks in the end examinations.

S.No.	Unit Name	No. of Questions		Weightage	Description
		Short	Essay		
1.	Remote Sensing	2	1	15	This unit covers the concepts of remote sensing along with basic, element of remote sensing, electromagnetic spectrum, remote sensing technology. It also includes satellite orbits, sensors and their types, satellites and their types. This unit also covers remote sensing data interpretation techniques, interpretation for terrain evaluation, spectral properties of soil, water & vegetation. Concept of image processing, image enhancement, qualitative & quantitative analysis, accuracy estimation.
2.	Introduction to GIS	2	1	15	This unit deals with the introduction, history and components of GIS along with their relief applications. Maps, Scales, types of scales, map and globes, map projections, map transformations can also be studied.
3.	Spatial Database Management System, Data models and Data Structures	2	1	15	This unit covers database management syste, spatial DBMS, data storage, E-R model. This also deals with GIS data model, Data structure, raster data, structure, geo database & metadata.
4.	Spatial Data Input and Editing & Spatial Analysis	2	1	15	This unit covers data input, methods such as keyboard entry, scanning, conversion of existing data, remotely sensed data, errors in data, data accuracy, sources of error in GIS. Along with topology, spatial analysis, network analysis,vector and raster data analysis, and spatial data interpolation techniques.
5.	Implementation and Applications of GIS	2	1	15	This unit deals with the awareness, developing system requirements. Also GIS based road network planning, mineral mapping using GIS, shortest path detection using GIS, hazard zonation using remote sensing and GIS, and GIS for business applications can also be studied.

It is sincerely hoped that this material will satisfy the expectations of students and at the same time helps them to score maximum marks in the exams.

Suggestions for improvement of the material from our esteemed readers will be highly appreciated and incorporated in our forthcoming editions.

SYLLABUS

Unit-1

Concepts of Remote Sensing Basics of Remote Sensing – Elements Involved in Remote Sensing, Electromagnetic Spectrum, Remote Sensing Terminology & Units, Energy Resources, Energy Interactions with Earth Surface Features & Atmosphere, Atmospheric Effects, Satellite Orbits, Sensor Resolution, Types of Sensors, Remote Sensing Platforms and Sensors, IRS Satellites.

Remote Sensing Data Interpretation Visual Interpretation Techniques, Basic Elements, Converging Evidence, Interpretation for Terrain Evaluation, Spectral Properties of Soil, Water and Vegetation, Concepts of Digital Image Processing, Image Enhancements, Qualitative & Quantitative Analysis and Pattern Recognition, Classification Techniques and Accuracy Estimation.

Unit-2

Introduction to GIS : Introduction, History of GIS, GIS Components, GIS Applications in Real Life, The Nature of Geographic Data, Maps Types of Maps, Map Scale, Types of Scale, Map and Globe, Co-ordinate Systems, Map Projections, Map Transformation, Geo-Referencing.

Unit-3

Spatial Database Management System : Introduction : Spatial DBMS, Data Storage, Database Structure Models, Database Management System, Entity-Relationship Model, Normalization.

Data Models and Data Structure : Introduction, GIS Data Model, Vector Data Structure, Raster Data Structure, Attribute Data, Geo-Database and Metadata.

Unit-4

Spatial Data Input and Editing : Data Input Methods – Keyboard Entry, Digitization, Scanning, Conversion of Existing Data, Remotely Sensed Data, Errors in Data Input, Data Accuracy, Micro and Macro Components of Accuracy, Sources of Error in GIS.

Spatial Analysis : Introduction, Topology, Spatial Analysis, Vector Data Analysis, Network Analysis, Raster Data Analysis, Spatial Data Interpolation Techniques.

Unit-5

Implementing a GIS and Applications

Implementing a GIS : Awareness, Developing System Requirements, Evaluation of Alternative Systems, Decision Making Using GIS

Applications of GIS

GIS Based Road Network Planning, Mineral Mapping Using GIS, Shortest Path Detection Using GIS, Hazard Zonation Using Remote Sensing and GIS, GIS for Solving Multi Criteria Problems, GIS for Business Applications.

MID - I & II

OBJECTIVE TYPE & ESSAY QUESTIONS WITH KEY

OBJECTIVE TYPE

UNIT - 1

I. Fill in the Blanks

1. Remote sensing data usually consists of intensity information in the form of _____.
2. The _____ remote sensing system utilizes its own energy to illuminate the object and records reflected energy.
3. The curve that is plotted showing variation of reflectance with respect to wavelength represents _____.
4. Balloons and air crafts are examples of _____ type of platforms.
5. The term that refers to the ratio of irradiance to radiant emittance of an object is _____.
6. _____ law explains the photo electric effect.
7. The peak and valley configuration of spectral reflectance curve represents _____.
8. _____ scattering is independent of wave length.
9. IFOV stands for _____.
10. The IRS satellites are used for the evaluation of _____.

II. Multiple Choice

1. The essential component of remote sensing system [ ]
   (a) Super sensor (b) Multiple data users
   (c) Uniform energy (d) All the above
2. The element induded in data acquisition process is. [ ]
   (a) Generation of sensor data (b) Visual image interpretation
   (c) Digital image processing (d) None of the above
3. For passive remote sensing system, the energy source is, [ ]
   (a) Infrared radiation (b) Its own energy
   (c) Solar radiation (d) UV radiation.
4. Synoptivity in satellite data is found in [ ]
   (a) Landscapes (b) Seascapes
   (c) Icescapes (d) All the above
5. Which of the following is not a limitation of remote sensing. [ ]
   (a) Ground resolution (b) Positional accuracy
   (c) Repetivity (d) Stereo viewing
6. The elements involved in visual interpretation process are, [ ]
   (a) Shape (b) Tone
   (c) Texture (d) All the above
7. In $m = \sigma T^4$, 'σ' is, [ ]
   (a) Wein's displacement constant (b) Planck's constant
   (c) Stetan's Boltzmann's constant (d) None of the above

8. The more regular curve configuration of spectral reflectance is exhibited by, [ ]
   (a) Vegetation (b) Soil
   (c) Water (d) All the above
9. Identify from the following, which do not affect the reflectance of soil. [ ]
   (a) Moisture content (b) Soil texture
   (c) Shape (d) Organic matter
10. Which of following is not a communication satellite [ ]
   (a) GSAT (b) RISAT
   (c) INSAT (d) HAMSAT

III. Match the Following

1. Data analysis	[ ]	(a)	NIMBUS
2. Electromagnetic spectrum	[ ]	(b)	Propagation
3. Meteorological satellite	[ ]	(c)	Digital image processing
4. Data acquisition	[ ]	(d)	SPOT satellite program
5. Earth resource satellite	[ ]	(e)	Transmittance

KEY

I. Fill in the Blanks

1. Wave length
2. Active
3. Spectral signature
4. Air borne
5. Reflectance
6. Planck's
7. Vegetation
8. Non-selective
9. Instantaneous Field of View
10. Natural resources

II. Multiple Choice

1. (d) 2. (a) 3. (c) 4. (d) 5. (c)
6. (d) 7. (c) 8. (b) 9. (c) 10. (b)

III. Match the Following

1. (c) 2. (e) 3. (a) 4. (b) 5. (d)

UNIT - 2

I. Fill in the Blanks

1. _____ data differentiates GIS with other information systems.
2. Points, lines and areas are the examples of _____ features that describe the locations of spatial features.
3. _____ coordinate system defines the locations of spatial features on earth's surface.
4. The simplest model that can better approximate the size and shape of earth is _____.
5. The geographic coordinates which depends on a ellipsoid are called as _____ coordinates.
6. The map projection which preserves the local shapes and angles is _____.
7. To modify y-coordinate readings, the method of assigning value to origin of coordinate system is called _____.
8. _____ defines the line of tangency between reference globe and projection surface.
9. In map projection, the value of scale factor along the standard line is _____.
10. _____ is not a map projection parameter.
11. _____ is the map projection, that is not used.
12. The ratio of local scale to scale of reference globe is _____.

II. Multiple Choice

1. Which of the following is not a component of GIS. [ ]
   (a) Infrastructure (b) Software
   (c) Hardware (d) Data
2. Pick up from the following, that is a part of GIS operation. [ ]
   (a) Data analysis (b) Data input
   (c) Data management (d) All the above
3. Which of the following is not a component of GIS? [ ]
   (a) Infrastructure (b) Software
   (c) Hardware (d) Data
4. Pick up from the following, that is a part of GIS operation. [ ]
   (a) Data analysis (b) Data input
   (c) Data management (d) All the above
5. The coordinate system, which uses locations as reference system for representing spatial features in GIS is, [ ]
   (a) Cartesian coordinate system (b) Plane coordinate system
   (c) Geographic coordinate system (d) Polar coordinate system
6. Identify from the following that is not a map projection parameter. [ ]
   (a) Multiple line (b) Central line
   (c) Standard line (d) All the above
7. To change the x-coordinates, the method of assigning value to origin of a coordinate system is [ ]
   (a) False northing (b) False southing
   (c) False westing (d) False easting

8. Pick up the map projection, that is not used [ ]
   (a) Cylindrical projection (b) Circular projection
   (c) Conical projection (d) Azimuthal projection
9. On geographic coordinate system, parallel measure locations in the direction of [ ]
   (a) E – S (b) E – W
   (c) N – S (d) N – E
10. The ratio of local scale to scale of reference globe is [ ]
   (a) Principal scale (b) Scale factor
   (c) Representative factor (d) Projected scale

III. Match the Following

1.	Data exploration [ ]	(a)	Locations of spatial features
2.	Attribute data [ ]	(b)	Data display
3.	GRS 80 [ ]	(c)	GIS operation
4.	Spatial data [ ]	(d)	Datum
5.	Map design [ ]	(e)	Characteristics of spatial features

KEY

I. Fill in the Blanks

1. Geospatial
2. Discrete
3. Geographic
4. Spheriod
5. Geodetic
6. Conformal projection
7. False northing
8. Standard line
9. 1(one)
10. Multiple line
11. Circular projection
12. Scalar factor

II. Multiple Choice

1. (c) 2. (d) 3. (c) 4. (d) 5. (b)
6. (a) 7. (d) 8. (b) 9. (c) 10. (b)

III. Match the Following

1. (c) 2. (e) 3. (d) 4. (a) 5. (b)

UNIT - 3

I. Fill in the Blanks

1. _____ is a collection of logically related data designed to meet the information requirements of one or more users.
2. DBMS _____ unauthorized access.
3. Database is a _____ application when data model used in conjuction with a database system.
4. The information of attribute related with a single map coverage is transformed by _____ operation.
5. _____ is a design technique using which relational databases are designed.
6. The set of all possible values of entity is called _____.
7. Attributes that are same but are used to describe the entity are knows as _____.
8. _____ Cannot be divided into subparts.
9. Based on _____nodes are classified into leaf and non-leaf nodes.
10. Block encoding is subdivided into _____ blocks.

II. Multiple Choice

1. _____ is a computer program used to store & manage large amount of data [ ]
   (a) Database (b) DBMS
   (c) Database model (d) Data storage
2. In GIS spatial data and attribute data are _____with each other [ ]
   (a) Linked (b) Not-linked
   (c) Not-equal (d) Equal
3. In _____,different application programs providing services to the user are collected [ ]
   (a) Database (b) Database model
   (c) Database structure model (d) File based method
4. The manipulation operations are also known as_____
   (a) Cartographic model (b) Database structure model
   (c) Data storage (d) File based method
5. Multimedia database is used for storing _____ [ ]
   (a) Geographical data (b) Audio messages
   (c) Graphical (d) Records
6. _____ is a logical structure of entire database
   (a) Internal level (b) External level
   (c) Conceptual level (d) Entity record
7. _____ describes the properties of the entity [ ]
   (a) Entity record (b) Attribute
   (c) Relationship (d) Cardinality
8. Relationship is represented by [ ]
   (a) ▭ (b) ⬭
   (c) ⬭ (d) ◇
9. In _____ nodes serves as a quadrat [ ]
   (a) Entity model (b) Run-length encoding
   (c) File structure (d) Quad tree
10. _____ defines the boundary of the entity [ ]
   (a) Block encoding (b) Chain encoding
   (c) Quad tree (d) Run-length encoding

III. Match the Following

1. Spatial	[ ]	(a)	Time
2. Fields	[ ]	(b)	Attribute
3. Temporal	[ ]	(c)	Rows
4. Tuples	[ ]	(d)	Position
5. Thematic	[ ]	(e)	Columns

KEY

I. Fill in the Blanks

1. Database
2. Restricts
3. Data model
4. Reclassification
5. Normalization
6. Entity type
7. Non-key attributes
8. Simple attributes
9. Cell values
10. Hierarchial

II. Multiple Choice

1.	(b)	2.	(a)	3.	(d)	4.	(a)	5.	(b)
6.	(c)	7.	(b)	8.	(d)	9.	(d)	10.	(b)

III. Match the Following

1. (d) 2. (e) 3. (a) 4. (c) 5. (b)

UNIT - 4

I. Fill in the Blanks

1. _____ data differentiates GIS with other information systems.
2. Points, lines and areas are the examples of _____ features that describe the locations of spatial features.
3. _____ coordinate system defines the locations of spatial features on earth's surface.
4. Continuous features of spatial data are better represented by _____ data.
5. DRG stands for _____.
6. The rater that is matched with projected coordinate system by processing is called _____.
7. The process of conversion of vector data into raster data is called _____.
8. RLE refers to _____.
9. _____ is the conversion from analog to digital data format.
10. The branch of geometry which gives different methods for the creation of spatial data of points, lines and polygon from survey data is _____.
11. DLG stands for _____.
12. On-screen digitzing is also called _____.
13. _____ gives information regarding geo spatial data.

II. Multiple Choice

1. To represent spatial variation of a feature, the raster data model uses [ ]
   (a) Lines (b) Grids
   (c) Points (d) Polygons
2. Identify the elements of raster data model [ ]
   (a) Cell value (b) Spatial reference
   (c) Raster bands (d) All the above
3. The process of conversion of raster data to vector data is [ ]
   (a) Rasterization (b) Digitization
   (c) Vectorization (d) Data editing
4. Example for the type of raster data [ ]
   (a) Satellite Imagery (b) Global DEM's
   (c) DRGs (d) All the above
5. GPS data and survey data are the type of [ ]
   (a) Remotely sensed data (b) Spatial data
   (c) Field data (d) None of the above
6. The structures examined by raster data structure are, [ ]
   (a) Cell by cell encoding (b) Quad tree
   (c) Run length encoding (d) All the above
7. The raster data structure used by DEM and satellite images [ ]
   (a) Header file (b) Cell-by-cell encoding
   (c) RLE (d) Quad tree

8. The efficient method for updating (or) editing the existing layer is [ ]
   (a) Scanning (b) Digitizing with tables
   (c) On-screen digitizing (d) None of the above
9. The format which is public (or) de facto for data exchange is [ ]
   (a) Neutral format (b) Direct translation
   (c) Vector product format (d) All the above.
10. The raster data structure that records values of cells by rows and groups is, [ ]
   (a) Quad tree (b) Run length encoding
   (c) Cell by cell (d) Header file.

III. Match the Following

1. Scanning	[ ]	(a)	Geospatial data
2. Global DEM	[ ]	(b)	Ground pixel size
3. On screen digitizing	[ ]	(c)	Data creation
4. Meta data	[ ]	(d)	Type of raster data
5. Spatial resolution of satellite image	[ ]	(e)	Manual digitizing

KEY

I. Fill in the Blanks

1. Geospatial
2. Discrete
3. Geographic
4. Raster
5. Digital Raster Graphic
6. Georeferenced raster
7. Rasterization
8. Run Length Encoding
9. Digitizing
10. Coordiante geometry (COGO)
11. Digital Line Graphs
12. Heads-up-digitizing
13. Metadata.

II. Multiple Choice

1.	(c)	2.	(d)	3.	(b)	4.	(b)	5.	(d)
6.	(c)	7.	(d)	8.	(c)	9.	(d)	10.	(b)
11.	(c)	12.	(a)	13.	(b)				

III. Match the Following

1. (c) 2. (d) 3. (e) 4. (a) 5. (b)

UNIT - 5

I. Fill in the Blanks

1. In ___ phase, the specific GIS needs are determined.
2. The decision-making process involves three phases, they are _____, _____, _____.
3. The representation of geological potential of deposits of certain types of minerals hosted in any particular area is known as _____.
4. GIS represents a location in _____ dimensional coordinates.
5. The method of ranking different parts of an area according to the degree of potential hazard caused by the landslides is known as _____.
6. _____approach is suited for small scale regional surveys.
7. _____ is used to logically evaluate and compare different criteria to make the best possible solution.
8. _____is used for shortest path detection.

II. Multiple Choice

1. GIS is a powerful tool used for_____.
   (a) Creating geospatial data
   (b) Managing geospatial data
   (c) Analysing geospatial data
   (d) All of the above
2. Which of these phases provides the detailed information necessary for GIS implementation?
   (a) Planning
   (b) Requirement analysis
   (c) Design phase
   (d) Acquisition and development
3. Which of the following is not the phases of decision-making process?
   (a) Intelligence phase
   (b) Acquisition and development
   (c) Design phase
   (d) Choice phase
4. GIS represents a location in _____ dimensional coordinates.
   (a) 2
   (b) 3
   (c) 5
   (d) 4
5. GIS represents data of _____.
   (a) Trees
   (b) Wate bodies
   (c) Lands
   (d) All of the above

6. Mapmakers use GIS to_____.
   (a) Store geographic information
   (b) Use geographic information
   (c) View geographic information
   (d) All of the above
7. Which of the following are the applications of web mapping?
   (a) Google maps
   (b) Open street maps
   (c) Bing maps
   (d) All of the above
8. Which of the following is used for developing vehicle route?
   (a) STAAD Pro
   (b) GIS
   (c) Autodesk
   (d) Remote sensing
9. Applications of GIS in business_____.
   (a) Banking
   (b) Diary industry
   (c) Tourism
   (d) All of the above

III. Match the Following

1. Shortest path detection	[ ]	(a)	Google maps
2. Mineral mapping	[ ]	(b)	1:25000 to 1:50000
3. Statistical quantitative approach	[ ]	(c)	Best possible alternative
4. Multi criteria decision analysis	[ ]	(d)	Representation of mineral deposits
5. Web mapping	[ ]	(e)	'Best first' algorithm

KEY

I. Fill in the Blanks

1. Requirements analysis
2. Intelligence phase, Design phase, Choice phase
3. Mineral mapping
4. 3-dimensional
5. Landslide hazard zonation
6. Heuristic qualitative approach
7. Multi criteria decision analysis
8. GIS

II. Multiple Choice

1. (d) 2. (b) 3. (b) 4. (b) 5. (d)
6. (d) 7. (d) 8. (b) 9. (d)

III. Match the Following

1. (e) 2. (d) 3. (b) 4. (c) 5. (a)

ESSAY QUESTION WITH KEY

UNIT - 1

Q1. What is remote sensing? Give its classification? **(Refer Unit-1, Q16)**
Q2. Explain the components of remote sensing with a neat sketch. **(Refer Unit-1, Q20)**
Q3. Discuss remote sensing terminology and units. **(Refer Unit-1, Q22)**
Q4. Discuss in detail about the electromagnetic spectrum. **(Refer Unit-1, Q25)**
Q5. Explain the major divisions of electromagnetic spectrum. **(Refer Unit-1, Q26)**
Q6. Briefly discuss the following :
   (a) Planck's law
   (b) Stephen Boltzmann's law
   (c) Wein's displacement law. **(Refer Unit-1, Q28)**
Q7. What are the types of scattering? Explain. **(Refer Unit-1, Q31)**
Q8. What are the different effects of atmosphere on spectral response? **(Refer Unit-1, Q33)**
Q9. What are the various orbits in which satellite can exist? Discuss. **(Refer Unit-1, Q36)**
Q10. List the Indian Satellite and Sensor resolution characteristics. **(Refer Unit-1, Q39)**
Q11. What do you mean by IRS? Give Examples. **(Refer Unit-1, Q41)**
Q12. Write in brief about the sensor characteristics of:
   (a) IRS satellite.
   (b) LANDSAT. **(Refer Unit-1, Q42)**
Q13. What is visual interpretation? What are the basic elements to be considered during visual interpretation of satellite images? **(Refer Unit-1, Q43)**
Q14. Explain the different applications of aerial photo interpretation. **(Refer Unit-1, Q45)**
Q15. Discuss spectral properties of soil, water and vegetation? **(Refer Unit-1, Q49)**
Q16. What do you mean by Digital Image Processing? Explain basic processes involved. **(Refer Unit-1, Q53)**
Q17. Discuss about the following image enhancement techniques
   1. Image reduction.
   2. Image magnification.
   3. Colour compositing.
   4. Transect extraction. **(Refer Unit-1, Q55)**
Q18. Explain the following techniques related to image enhancement.
   1. Contrast enhancement
   2. Filtering. **(Refer Unit-1, Q56)**
Q19. Explain image classification. **(Refer Unit-1, Q58)**

UNIT - 2

Q1. Write a note on the history of GIS. **(Refer Unit-2, Q12)**
Q2. Discuss the various components of GIS in detail. **(Refer Unit-2, Q13)**
Q3. Explain the different operations performed in GIS? **(Refer Unit-2, Q15)**
Q4. Explain the four M's concept in GIS. **(Refer Unit-2, Q17)**
Q5. Discuss in brief various applications of GIS in civil engineering. **(Refer Unit-2, Q19)**
Q6. Differentiate between spatial and non-spatial data.
Q7. Explain the following, (a) GIS queries (b) GIS architecture. **(Refer Unit-2, Q24)**
Q8. Explain map scale and mention its types? **(Refer Unit-2, Q26)**

Q9. Write about coordinate system. Discuss different coordinate system? (Refer Unit-2, Q28)
Q10. Explain the types of Map projections with necessary diagrams. (Refer Unit-2, Q31)
Q11. What are the commonly used map projections in GIS? Explain the advantages. (Refer Unit-2, Q35)
Q12. List and explain commonly used Map Projections along with its significance. (Refer Unit-2, Q37)
Q13. Explain the UTM Grid system and state its limitations. (Refer Unit-2, Q39)
Q14. Write about georeferencing?

UNIT - 3

Q1. Discuss about special DBMS (Refer Unit-3, Q9)
Q2. Describe database management system. Mention its advantages. (Refer Unit-3, Q11)
Q3. Discuss about entity-relationship model and explain the components of database. (Refer Unit-3, Q12)
Q4. Discuss entity-relationship model with typical example. (Refer Unit-3, Q13)
Q5. Describe various data structure models. (Refer Unit-3, Q15)
Q6. Describe various GIS data models. (Refer Unit-3, Q18)
Q7. Give the classification of simple and topological features. (Refer Unit-3, Q20)
Q8. Write a note on geodatabase. (Refer Unit-3, Q22)
Q9. Explain Metadata. (Refer Unit-3, Q23)

UNIT - 4

Q1. Discuss various sources of data input methods in GIS environment and their merits and demerits. (Refer Unit-4, Q16)
Q2. Differentiate between Manual Digitization and Automated Digitization. (Refer Unit-4, Q17)
Q3. Discuss the various types of errors occur during digitization with sketches. (Refer Unit-4, Q20)
Q4. Explain in detail about the following data sources in creating new data,
1. Remotely senses data
2. Field data. (Refer Unit-4, Q22)
Q5. Explain the components of data accuracy. (Refer Unit-4, Q24)
Q6. Describe sources of errors in GIS? (Refer Unit-4, Q25)
Q7. What is topology? Describe with sketches, types of topology established based on entities. (Refer Unit-4, Q26)
Q8. Write about vector data analysis. List different vector data analysis and explain any one? (Refer Unit-4, Q29)
Q9. Explain map manipulation? (Refer Unit-4, Q32)
Q10. Write about local operations. (Refer Unit-4, Q34)
Q11. Explain about neighborhood operations. (Refer Unit-4, Q35)
Q12. Explain Zonal Operations. (Refer Unit-4, Q36)

UNIT - 5

Q1. Explain the decision-making process by using GIS. (Refer Unit-5, Q10)
Q2. Explain the use of GIS in Mineral Mapping? (Refer Unit-5, Q12)
Q3. Write a short note on the detection of shortest path using GIS. (Refer Unit-5, Q13)
Q4. Explain briefly about the use of GIS in hazard zonation. (Refer Unit-5, Q15)
Q5. Explain the use of GIS in multi criteria decision analysis. (Refer Unit-5, Q17)
Q6. Discuss the uses of GIS for business applications (Refer Unit-5, Q18)

R18

Jawaharlal Nehru Technological University Hyderabad

B.Tech. IV Year I Semester Examination

MODEL PAPER 1

REMOTE SENSING AND GIS

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two **Parts A and B,**
Part A is compulsory which carries **25 marks**. Answer all questions in **Part A**.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries **10 marks** and may have a, b, c as sub questions.

Solutions

PART-A

1. (a) Define and explain remote sensing. (Unit-1 / Q1)
(b) Define Geographic Information System (GIS). (Unit-2 / Q1)
(c) What is database management system? (Unit-3 / Q2)
(d) What is scanning? (Unit-4 / Q3)
(e) What is the need for implementing GIS? (Unit-5 / Q1)
(f) Write a short note on absorption of ozone. (Unit-1 / Q7)
(g) What do you understand by attribute data? (Unit-2 / Q6)
(h) What are methods of data storage? (Unit-3 / Q4)
(i) What is a 'Topology'? (Unit-4 / Q7)
(j) What is 'landslide hazard zonation'? (Unit-5 / Q6)

PART-B

2. What is remote sensing? Give its classification? (Unit-1 / Q16)

OR

3. (a) Discuss remote sensing terminology and units. (Unit-1 / Q22)
(b) What are the advantages and disadvantages of using remotely sensed data? (Unit-1 / Q23)
4. Explain the basic concept of GIS. (Unit-2 / Q11)

OR

5. What are the applications of GIS. (Unit-2 / Q18)
6. Discuss about entity-relationship model and explain the components of database. (Unit-3 / Q12)

OR

7. (a) Explain the methods of data storage. (Unit-3 / Q10)
(b) Write a note on data models. (Unit-3 / Q17)
8. (a) Explain in detail different data input methods in GIS. (Unit-4 / Q16)
(b) What are the errors observed in the conversion of the data? (Unit-4 / Q20)

OR

9. (a) What do you mean by Vector overlay? Explain Point-in-polygon overlay, Line-on-polygon overlay, Polygon-on-polygon overlay. (Unit-4 / Q30)
(b) Explain about neighborhood operations. (Unit-4 / Q35)
10. Discuss briefly about the GIS planning and implementation process. (Unit-5 / Q9)

OR

11. (a) Write a short note on the detection of shortest path using GIS. (Unit-5 / Q13)
(b) Explain briefly about the use of GIS in hazard zonation. (Unit-5 / Q15)

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Jawaharlal Nehru Technological University Hyderabad

B.Tech. IV Year I Semester Examination

MODEL PAPER 2

REMOTE SENSING AND GIS

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two **Parts A and B,**

Part A is compulsory which carries **25 marks**. Answer all questions in **Part A**.

Part B consists of 5 Units. Answer any one full question from each unit.

Each question carries **10 marks** and may have a, b, c as sub questions.

Solutions

PART-A

1. (a) List the advantages of remote sensing. (Unit-1 / Q3)
   (b) What are the fundamental operations of GIS? (Unit-2 / Q4)
   (c) Write the advantages of DBMS. (Unit-3 / Q3)
   (d) Explain 'on screen digitizing'. (Unit-4 / Q4)
   (e) Discuss the application of GIS in transportation planning. (Unit-5 / Q3)
   (f) Explain 'resolution' in remote sensing with examples. (Unit-1 / Q11)
   (g) Explain how you will link spatial and attribute data. (Unit-2 / Q7)
   (h) What is normalization? (Unit-3 / Q8)
   (i) List the topology rules. (Unit-4 / Q8)
   (j) Write short notes on Multi-Criteria Decision Analysis(MCDA). (Unit-5 / Q7)

PART-B

2. (a) Explain the components of remote sensing with a neat sketch. (Unit-1 / Q20)
   (b) Explain the phenomenon of energy interactions with earth's surface materials. (Unit-1 / Q29)

   OR

3. (a) What are the types of resolution involved in Remote Sensing? Explain. (Unit-1 / Q38)
   (b) Write in brief about the sensor characteristics of:
      (a) IRS satellite. (Unit-1 / Q42)
      (b) LANDSAT.
4. Explain the four M's concept in GIS. (Unit-2 / Q17)

   OR

5. Write about coordinate system. Discuss different coordinate system? (Unit-2 / Q28)
6. (a) Write a note on normalization. (Unit-3 / Q16)

   OR

7. Describe raster data structure. (Unit-3 / Q21)
8. Differentiate between Manual Digitization and Automated Digitization. (Unit-4 / Q17)

   OR

9. (a) Discuss the importance of topology in GIS. (Unit-4 / Q27)
   (b) Write about vector data analysis. List different vector data analysis and explain and one? (Unit-4 / Q29)
10. (a) Explain the decision-making process by using GIS. (Unit-5 / Q10)
    (b) Explain the use of GIS in Mineral Mapping? (Unit-5 / Q12)

    OR

11. (a) Write a short note on the detection of shortest path using GIS. (Unit-5 / Q13)
    (b) Explain the use of GIS in multi criteria decision analysis. (Unit-5 / Q17)

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B.Tech. IV Year I Semester Examination

MODEL PAPER 3

REMOTE SENSING AND GIS

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two **Parts A and B,**

Part A is compulsory which carries **25 marks**. Answer all questions in **Part A**.

Part B consists of 5 Units. Answer any one full question from each unit.

Each question carries **10 marks** and may have a, b, c as sub questions.

Solutions

PART-A

1. (a) Write a short note on atmosphere properties. (Unit-1 / Q6)
   (b) Discuss the advantages of GIS. (Unit-2 / Q5)
   (c) Write a note on database models. (Unit-3 / Q5)
   (d) Define data conversion. What are the various formats included in conversion of existing data? (Unit-4 / Q6)
   (e) What is Mineral mapping? (Unit-5 / Q4)
   (f) Write in brief about an image. (Unit-1 / Q15)
   (g) What is map projection? (Unit-2 / Q9)
   (h) What is attribute data? (Unit-3 / Q7)
   (i) Explain brief about TIGER vector model. (Unit-4 / Q10)
   (j) What is the use of GIS for business? (Unit-5 / Q8)

PART-B

2. (a) What are the types of scattering? Explain. (Unit-1 / Q31)
   (b) Explain the following satellites,
      (i) Sun synchronous satellites
      (ii) Geostationary satellites
      (iii) Polar orbiting satellites
      (iv) Earth resources satellites. (Unit-1 / Q35)

   OR

3. (a) Explain the different applications of aerial photo interpretation. (Unit-1 / Q45)
   (b) Explain the following techniques related to image enhancement.
      1. Contrast enhancement
      2. Filtering.

      (Unit-1 / Q56)
4. Explain map scale and mention its types? (Unit-2 / Q26)

   OR

5. (a) Explain the types of Map projections with necessary diagrams. (Unit-2 / Q31)
   (b) Explain the UTM Grid system and state its limitations. (Unit-2 / Q37)

6. Write a note on geographic entities encoded using the vector data model. (Unit-3 / Q19)

OR

7. (a) Write a note on geodatabase. (Unit-3 / Q22)
   (b) Explain Metadata. (Unit-3 / Q23)

8. (a) Explain in detail about the following data sources in creating new data,
      1. Remotely senses data
      2. Field data. (Unit-4 / Q25)
   (b) What is topology? Describe with sketches, types of topology established based on entities. (Unit-4 / Q28)

OR

9. (a) Explain map manipulation? (Unit-4 / Q32)
   (b) Write about physical distance measuring operations. (Unit-4 / Q37)

10. (a) Explain about the applications of GIS in mining Industry. (Unit-5 / Q11)
    (b) Explain different methodological approaches of GIS when used for hazard assessment. (Unit-5 / Q16)

OR

11. Discuss the uses of GIS for business applications. (Unit-5 / Q18)

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Jawaharlal Nehru Technological University Hyderabad

B.Tech. IV Year I Semester Examination

REMOTE SENSING AND GIS

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two **Parts A** and **B**.

Part A is compulsory which carries 25 marks. Answer **All** questions in **Part A**.

Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A

1. (a) Define and explain remote sensing. **Refer Unit-1, Q1**
   (b) Write short notes on GIS categories. **Refer Unit-2, Q3**
   (c) What is database management system? **Refer Unit-3, Q2**
   (d) Define scanning and also mention its uses. **Refer Unit-4, Q3**
   (e) What is the need for implementing GIS? **Refer Unit-5, Q1**
   (f) Write a short note on energy interaction with earth surface features. Sketch the approximate shape of the reflactance curve for clear water and turbid water. **Refer Unit-1, Q8**
   (g) Discuss the advantages of GIS. **Refer Unit-2, Q5**
   (h) Write a note on database models. **Refer Unit-3, Q5**
   (i) List out various errors in digitizing. **Refer Unit-4, Q9**
   (j) What is 'landslide hazard zonation'? **Refer Unit-5, Q6**

PART-B

2. (a) Explain in detail about the remote sensing data,input. **Refer Unit-1, Q18**
   (b) Briefly discuss the following :
      (a) Planck's law
      (b) Stephen Boltzmann's law
      (c) Wein's displacement law. **Refer Unit-1, Q28**

OR

3. (a) What are sensors? How are the sensors classified based on their functions? **Refer Unit-1, Q37**
   (b) Explain the different applications of aerial photo interpretation. **Refer Unit-1, Q45**

4. (a) Discuss the various components of GIS in detail. **Refer Unit-2, Q13**
   (b) Differentiate between spatial and non-spatial data. **Refer Unit-2, Q21**

OR

5. (a) Explain about the maintenance and analysis of the spatial data. **Refer Unit-2, Q22**
   (b) What are the uses and limitations of maps? **Refer Unit-2, Q30**

6. (a) Discuss about special DBMS. **Refer Unit-3, Q9**

(b) Describe database management system. Mention its advantages. **Refer Unit-3, Q11**

OR

7. (a) Describe various GIS data models. **Refer Unit-3, Q18**

(b) Explain Metadata. **Refer Unit-3, Q23**

8. (a) Differentiate between Manual Digitization and Automated Digitization. **Refer Unit-4, Q17**

(b) Explain in brief about the neutral format of data conversion. **Refer Unit-4, Q21**

OR

9. (a) What do you understand by spatial analysis? Why is it required? Mention any two spatial analysis techniques. **Refer Unit-4, Q28**

(b) Discuss about following vector data analysis.

1. Distance measurement.
2. Pattern analysis. **Refer Unit-4, Q31**

10. Discuss briefly about the GIS planning and implementation process. **Refer Unit-5, Q9**

OR

11. Explain the use of GIS in multi criteria decision analysis. **Refer Unit-5, Q17**

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Jawaharlal Nehru Technological University Hyderabad

B.Tech. IV Year I Semester Examination

REMOTE SENSING AND GIS

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two **Parts A** and **B**.

Part A is compulsory which carries 25 marks. Answer **All** questions in **Part A**.

Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A

1. (a) Write a short note on atmosphere properties. **Refer Unit-1, Q6**

(b) Explain how you will link spatial and attribute data. **Refer Unit-2, Q7**

(c) What are methods of data storage? **Refer Unit-3, Q4**

(d) Define data conversion. What are the various formats included in conversion of existing data? **Refer Unit-4, Q6**

(e) Discuss the application of GIS in transportation planning. **Refer Unit-5, Q3**

(f) What are the different interpretation keys? **Refer Unit-1, Q13**

(g) What is map projection? **Refer Unit-2, Q9**

(h) What is attribute data? **Refer Unit-3, Q7**

(i) Write a short note on Spatial data analysis. **Refer Unit-4, Q11**

(j) What is the use of GIS for business? **Refer Unit-5, Q8**

PART-B

2. (a) Explain the procedure of electromagnetic remote sensing. **Refer Unit-1, Q21**

(b) Explain briefly about the atmospheric interactions with electromagnetic radiation. **Refer Unit-1, Q30**

OR

3. (a) What are the different platforms that are used in remote sensing? **Refer Unit-1, Q40**

(b) Discuss about the following image enhancement techniques

1. Image reduction.
2. Image magnification.
3. Colour compositing.
4. Transect extraction. **Refer Unit-1, Q55**

4. Explain the different operations performed in GIS? **Refer Unit-2, Q15**

OR

5. (a) Define map and give its classification? **Refer Unit-2, Q25**

(b) Discuss about geometric transformation? **Refer Unit-2, Q38**

6. (a) Write about object oriented database. **Refer Unit-3, Q14**

   (b) Write a note on normalization. **Refer Unit-3, Q16**

   OR

7. Give the classification of simple and topological features. **Refer Unit-3, Q20**

8. (a) Explain in detail about the following data sources in creating new data,

      1. Remotely senses data

      2. Field data. **Refer Unit-4, Q22**

   (b) What is topology? Describe with sketches, types of topology established based on entities. **Refer Unit-4, Q24**

   OR

9. (a) Write about local operations. **Refer Unit-4, Q34**

   (b) Explain Zonal Operations. **Refer Unit-4, Q36**

10. (a) Explain the decision-making process by using GIS. **Refer Unit-5, Q10**

    (b) Explain different methodological approaches of GIS when used for hazard assessment. **Refer Unit-5, Q16**

    OR

11. Discuss the uses of GIS for business applications. **Refer Unit-5, Q18**

UNIT 1

REMOTE SENSING

Syllabus

Concepts of remote sensing basics of remote sensing - Elements involved in remote sensing, Electromagnetic spectrum, Remote sensing terminology & units, energy resources, Energy Interactions with earth Surface features & atmosphere, Atmospheric effects, Satellite orbits, Sensor resolution, Types of sensors, Remote sensing platforms and sensors, IRS satellites.

Remote sensing data interpretation visual interpretation techniques, Basic elements, Converging evidence, Interpretation for terrain evaluation, Spectral properties of soil, Water and vegetation, Concepts of digital Image processing, Image enhancements, qualitative & quantitative analysis and pattern recognition, Classification techniques and accuracy estimation.

LEARNING OBJECTIVES

On completion of this unit, the student shall be able to understand the following concepts,

- Concepts and elements involved in remote sensing
- Electromagnetic spectrum, remote sensing terminology and units
- Sensors and types of sensors
- Remote sensing data interpretation visual interpretation techniques and their basic elements
- Interpretation of terrain evaluation
- Spectral properties of soil, water and vegetation
- Concepts of digital image processing, image enhancements along with qualitative and quantitative analysis
- Classification techniques and accuracy estimation

INTRODUCTION

The word remote means far away and the word sensing means acquiring information. Remote sensing is the art and science to obtain information of a particular object, phenomenon under investigation, phenomenon through data analysis achieved by a device which is away from the object. Now-a-days the remote sensing is limited to mean the process of achieving information of an object without its physical contact irrespective of whether it is miles away from the object or very close to it. It is also required that, in the absence of any matter such sensing may be achieved in the intervening space between observer and the object.

POINTS TO REMEMBER

- **Remote Sensing :** It is the art and science to obtain information of a particular object, phenomenon under investigation, phenomenon through data analysis achieved by a device which is away from the object.
- **Concept of Remote Sensing :** It is explained by taking computer monitor as an activity. A person viewing a screen of a computer monitor is said to be actively engaged in remote sensing.
- **Absorption of Ozone :** In stratospheric level fo 20 to 40 km, ozone is a trace gas. It dominates the short wave radiation budget at these levels and the effect is low at other heights.
- **Image :** It is a picture which is result of the sensing process. It is displayed on the monitor of a computer or its copy is printed.
- **Satellite :** It is a artificial or natural object that revolves around the earth or any other planet or star. The instrument carried by the remote sensing satellite records images of the earth which are then transmitted to receiving station using radio waves.
- **RADARSAT :** It is a remote sensing satellite that uses radar technology to take pictures of earth's surface.
- **LANPSAT :** It is a series of remote sensing satellites to record the images of the earth's surface by using infrared and visible band of spectrum.
- **Sensor :** It is similar to camera that records remote sensing image.

PART-A SHORT QUESTIONS WITH SOLUTIONS

Q1. Define and explain remote sensing.

Model Paper-I, Q1(a)

Answer :

Remote sensing is the art and science to obtain information of a particular object, phenomenon under investigation, phenomenon through data analysis achieved by a device which is away from the object. Now-a-days the remote sensing is limited to mean the process of achieving information of an object without its physical contact irrespective whether it is miles away from the object or very close to it. It is also required that, in the absence of any matter such sensing may be achieved in the intervening space between observer and the object.

Q2. Explain the basic concept of remote sensing.

Answer :

Basic Concept of Remote Sensing

The concept of remote sensing is explained by taking computer monitor as an activity. A person viewing a screen of a computer monitor is said to be actively engaged in remote sensing.

The light emanates from that screen of monitor is a source of radiation. The light passes over a distance and therefore it is remote until it is captured by a sensor (eyes). The eyes sends a signal to a process (brain). The data is recorded and interprets into information. The awareness of the external world is gathered by several human senses by observing various signals reflected or emitted. Therefore, the person hears disturbances carried as sound waves in atmosphere.

Q3. List the advantages of remote sensing.

Answer : [May-19, R16, Q1(c) | Model Paper-II, Q1(a)]

Advantages of Remote Sensing

1. The remotely sensed data records the satellite images permanently, so that the information can be provided in different wavebands.
2. It provides regional survey of maximum area coverage for the purpose of identifying large characteristics of different themes.
3. The dynamic themes such as water, agriculture are recorded due to repetitive coverage.
4. Data can be collected easily at various scales and resolutions.

Q4. How does the atmospheric conditions influence the remote sensing?

Answer :

Remote sensing is influenced by the atmospheric conditions in two ways, which are as follows.

(a) In the traverse condition of atmosphere, the information reflected or radiated by the surface of the earth can be altered.

(b) The absorption, reflection and scattering are utilized for estimating the temperature, pressure profiles, cloud heights, particulate and gas analysis, which is an advantageous effect on remote sensing.

Q5. What are the range of wavelengths in the various EMR spectrum?

Answer :

The various ranges of wavelength in EMR spectrum are shown in the table given below:

S.no	Parts of EMR spectrum	Wavelength (μm)
1.	Gamma rays	less than 0.03
2.	X-rays	0.03 to 0.3
3.	Ultraviolet rays	0.3 to 0.4
4.	Visible region	0.4 to 0.7
5.	Infrared region	0.7 to 1.0
6.	Reflected infrared band	0.7 to 3.0
7.	Thermal infrared band	3.0 to 5.0
8.	Radar	0.1 to 30 cm
9.	Radio waves	Greater than 30 cm

Q6. Write a short note on atmosphere properties.

Answer : Model Paper-III, Q1(a)

The measurement of main part of the radiance from high flying aircraft leads to multiple scattering in the atmosphere. Thus the interpretation of remaining signal is carried out in terms of suspensions after a correction for atmospheric contribution. This is the reason the differing optical parameters of atmosphere should join the radiative transfer calculations. The emission of sun in a broad spectral range is the source of short wave radiation field in atmosphere. The solar constant and the extraterrestrial irradiance depends on absorption and scattering process in the chromosphere of sun and the black body emission of sun's photosphere.

Q7. Write a short note on absorption of ozone.

Answer : Model Paper-I, Q1(f)

In stratospheric level of 20 and 40 km, ozone is a trace gas. It dominates the short wave radiation budget at these levels and the effect is low at other heights.

The chlorophyll fluorescence transferred to the top of atmosphere is hindered by the process of absorption of molecular oxygen and water vapour in their bands. The study of selective gaseous absorption in radiative transfer calculations is carried out by computing the transmission functions of oxygen and water from the parameters of absorption line.

Q8. Write a short note on energy interaction with earth surface features. Sketch the approximate shape of the reflactance curve for clear water and turbid water.

Answer :

Energy Interaction with Earth Surface Features

The proportions of energy that are absorbed, radiated and transmitted are unique to each and every earth feature. This unique spectral reflectance property is defined as the spectral signature of the earth feature. This proportions of energy that are absorbed, radiated and transmitted changes based on the wavelength of the energy and type of material with which they are interacted.

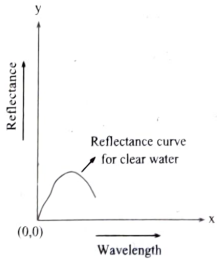


Figure: Showing the Reflectance Curve for Clear Water

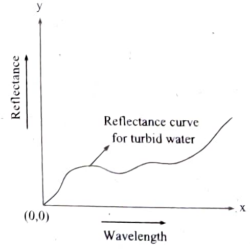


Figure: Showing the Reflectance Curve for Turbid Water

Q9. What are the various characteristics of a satellite?

Answer :

Characteristics of Satellite

(i) The orbit of the satellite is near-polar, sun-synchronous.
(ii) The satellite has 99.03 degrees inclination.
(iii) The altitude of the satellite is 904 km.
(iv) The satellite has 22 days of repeat cycle.
(v) The eccentricity of the satellite is 0.002.
(vi) The satellite has 103 minutes of period.
(vii) The equatorial crossing time of satellite is 10.00 hours.

Q10. Write about meteorological satellites.

Answer : May-19 (R16), Q1(d)

Meteorological Satellites

The satellites which are specially designed to monitor and predict the climatic variations and weather condition of the earth surface are known as meteorological satellites.

These satellites are incorporated with very larger spatial resolution sensors compared to other satellites. Based on their orbits, these satellites are characterized into two types. They are,

1. **Geostationary Meteorological Satellite**

The satellite which remains in geosynchronous orbit of our earth is known as Geostationary Meteorological Satellite.

2. **Polar-Orbit Meteorological Satellite**

The satellite which remains in polar orbit of our earth is known as Polar-Orbit Meteorological Satellite.

Q11. Explain 'resolution' in remote sensing with examples.

Answer : Model Paper-II, Q1(f)

Resolution

The resolution describes the smallest object comprises in a data. The resolution and scale are related to each other because the object size has lower limit that can be shown of paper map. Usually this limit is assumed as a thumb rule to be 0.45 mm, such that the effective resolution of 1:1000 map is about 50 cm.

Geospatial databases are generalised intentionally by which the resolution is limited. The level of detail should be matched by the database resolution required for the application. Resolution plays an important role in interpreting accuracy. Example: The spatial accuracy levels of two databases may be nearly equal but if there are different spatial resolutions, then the levels of accuracy does not give the same quantity level.

Q12. What is visual interpretation?

Answer :

Visual interpretation is defined as the process to analyse the objects and to evaluate their importance by examining satellite imageries. It is widely used for locating specific features and conditions and has been used in many fields, which includes agriculture, archeaology, conservation, engineering, forestry, geology, geography, meteorology, military intelligence, natural resource management, oceanography, soil science and urban and regional planning.

Visual image interpretation technique is significant and may require extensive training for the users. This has become more significant for creating spatial database for geographical information system.

Visual interpretation includes:

(a) Detection of objects
(b) Recognition of objects
(c) Identification of objects
(d) Classification of objects
(e) Delineation of objects.

Q13. What are the different interpretation keys?

Answer :

A set of guidelines used to assist interpreters in identifying features quickly are known as interpretation keys. The different interpretation keys are,

(i) Selective keys
(ii) Elimination keys.

(i) Selective Keys

The arrangement of selective keys are done in such a way that the example is selected by the interpreter that relates closely to the object.

(ii) Elimination Keys

The arrangement of elimination keys are done in such a way that a precise stepwise process is followed by the interpreter that results in the elimination of all targets except the one which the interpreter is trying to find out.

Q14. What is meant by converging evidence in image interpretation for terrain evaluation?

Answer :

Converging Evidence

Converging evidence is defined as the process of converging the description of all the interpretated information of key elements. This process is used for increasing the accuracy of visual interpretation. In visual image interpretation, all the key elements are analysed (or) evaluated by identifying the terrain information on aerial photograph (or) space images. The information obtained by analysing the key terrain elements are converged, in order to draw the inference curve. The inferences drawn are used for GIS data input, manipulation and analysis.

Q15. Write in brief about an image.

Answer : Model Paper-III, Q1(f)

An image can be considered as a two dimensional plane, in which the variation of intensity or brightness at each point depends upon the scene. An image of any scene can be stored, processed, displayed and recorded by an image processing system. Image is categorized into two types as, analog image and digital image. An analog image is composed of a continuous range of values indicating position and intensity. A digital image is composed by finite number of image elements called picture elements or pixels.

PART-B ESSAY QUESTIONS WITH SOLUTIONS

1.1 Concepts Of Remote Sensing

1.1.1 Basics of Remote Sensing, Elements Involved In Remote Sensing, Remote Sensing Terminology and Units

Q16. What is remote sensing? Give its classification?

Answer : Model Paper-I, Q2

Remote Sensing

The word 'remote' means far away and the word 'sensing' means acquiring information or believing or observing. Remote sensing means to acquire information of things from far away places. Among all the five senses of human, three senses are considered as remote sensors i.e., sense of sight, sense of smell and sense of hearing. Remaining two senses i.e., sense of touch and sense of taste are not considered as remote sensors because the object is being touched by our organs to collect the information.

Nowadays remote sensing is performed by using satellites, digital cameras and sensors.

1. **Classification on Energy Source**

Sun is the natural source of energy and it is very suitable for remote sensing. The energy of sun is either reflected (for visible and reflective infrared wavelengths) or absorbed and then re-emitted (for thermal infrared wavelengths). Remote sensing systems used for measuring the naturally occurring energy are known as passive sensors and corresponding remote sensing is called passive remote sensing. Passive remote sensing within the optical region is possible only when the sun illuminates as at night there is no reflected energy.

But, naturally emitted energy of thermal infrared wavelengths and microwave region can be detected in both day and night. On the other hand, Active sensors provide their own source of energy for illumination. These sensors emit radiation in the direction of the target to be investigated. The radiation which is reflected from the target is detected and measured by the active sensor. Accordingly, remote sensing is referred as active remote sensing.

Thus under this classification there are two types of remote sensing. They are,

(i) Passive remote sensing.
(ii) Active remote sensing.

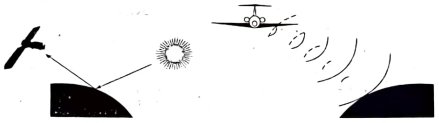


Figure : Remote Sensing

2. **Classification Depending on Platform**

A stable platform located at a distance from the target is necessary to collect and record energy emitted from a target. Remote sensor platform is situated on the ground, or on an aircraft, or on a satellite outside the earth's atmosphere.

Among these three platforms, mainly data collected from remote sensing is due to platforms within the air and platforms in the space. Platforms within the air such as air crafts, balloons, kites, pigeons etc., are called as airborne or aerial platforms and plat forms in the space such as air crafts, balloons, kites, pigeons etc., are called as airborne or aerial platforms and platforms in the space such as satellites are called as space or space borne plate forms. Corresponding types of remote sensing are,

(i) Ground level remote sensing
(ii) Air bore or aerial or sub or tical remote sensing.
(iii) Space or space borne or obriotital remote sensing.

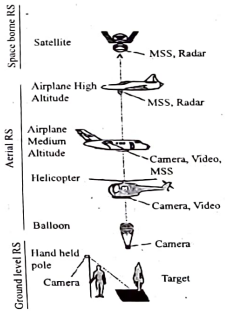


Figure : Remote Sensing Platforms

3. Classification Depending on the Regions of Electromagnetic Spectrum

Remote sensing is classified into four types based on regions of electromagnetic spectrum. They are,

(i) Optical remote sensing : This type of remote sensing used within the range of optical region (0.3 μm to 3 μm).

(ii) Photographic remote sensing : It is used within the range of photographic region (0.3 μm to 0.9 μm).

(iii) Thermal remote sensing : It is used within the range of thermal infrared region (3 μ to 1 mm).

(iv) Microwave remote sensing : It is used within the range of microwave region (1 mm to 1 m).

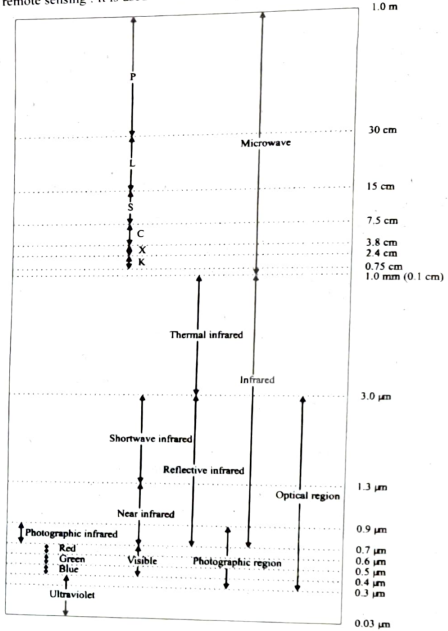


Figure : Bands of Electromagnetic spectrum

4. Classification Depending on Imaging Media

The image of the energy reflected or emitted from surface is taken either photographically or digitally. During the process of photographic imaging, chemical reaction takes place on the surface of light. Sensitive film for detecting and recording energy variations. Whereas in digital imaging, electronic transducers like charge coupled devices are used by the sensors. Corresponding remote sensing is referred as,

(i) Photographic imaging remote sensing.

(ii) Digital imaging remote sensing.

Photographic imaging remote sensing is employed in aeroplanes and spacecrafts. Digital imaging remote sensing is used in satellites and aeroplanes. In satellites, photographic imaging cannot be used since satellite remains in the space throughout its life, it is not possible to get the photographically recorded film to earth. Satellite transmits the digitally recorded data to earth through digital communication link.

5. Classification Depending on Number of Bands

(i) Panchromatic Remote Sensing

Where reflected, emitted or backscattered energy from an object is collected in a single band of electromagnetic spectrum then it is knows as panchromatic remote sensing. In this type of sensing images are collected within the range of visible region (0.4 – 0.7 μm). In few cases wider region (Examples, 0.3 – 0.9 μm or 0.3 – 3 μm) is also used. Important to realize that even if a sensor is capable of collecting energy in a single band in microwave region it cannot be referred as panchromatic image. It must use the visible region or a wider region which contains visible region.

(ii) Multi - Spectral Remote Sensing.

When reflected, emitted or back scattered energy from an object is collected in a multiple bands of electromagnetic spectrum then it is known as multi - spectral remote sensing. In this type of sensing energy is detected by multispectral sensors in a less number of broad wavelength bands. It can be performed in optical (0.3 to 3 μm), thermal (3 μm to 1 mm) and microwave (1 mm to 1 m) regions.

(iii) Hyper - Spectral Remote Sensing

It is the extension of multispectral remote sensing technique. The images produced by multispectral sensors are very few with broad wavelength bands whereas images produced by hyper - spectral sensors as are in dozens or hundreds with adjacent spectral bands. It is performed in optical region (0.3 to 3 μm) of electromagnetic spectrum.

Q17. Explain the classification of remote sensing system.

Answer :

Classification of Sensing System

The sensing system is broadly classified into two types. There are as follows,

1. Active sensing system
2. Passive sensing system.

1. Active Sensing System

The active remote sensing system generates its own energy to illuminate the target and record the reflected energy. The microwave part in electromagnetic spectrum forms the base for operating active remote sensing system. This type of system does not rely on solar radiation, as the solar radiation gets neglected in the microwave region. The wavelength of active remote sensing system is greater than 1 mm. The best example of this type of system is synthetic aperture radar.

2. Passive Sensing System

The passive remote sensing system generates its energy based on solar radiation in order to illuminate the target. The visible and infrared part in electromagnetic spectrum forms the base for operating the passive remote sensing system. The wavelength of passive remote sensing system lies between 0.4 to 1 μm. Any electromagnetic remote sensing system is the example of passive remote sensing system.

Q18. Explain in detail about the remote sensing data input.

Answer :

Remote Sensing Data Input

The remote sensing data obtained from aircraft and satellite are analysed through digital and analog forms in order to update rapid data and building temporal database for large areas. In remote sensing data input, digital datas are obtained based on raster format in which pixels records the electromagnetic radiations as number of radiometric values, depending on the type of system used. Input data from raster GIS are easily obtained, because raster GIS is similar to data structure. When remotely sensed data are considered as input to GIS, then such data are used for determining the cost, utility and accuracy compared to data from alternate sources. Under remotely sensed input data, exotic data are avoided whenever possible.

Most of the maps like topographical, soil and stereo are obtained from aerial photography. Therefore, such photography acts as a primary source for obtaining base map data for various products. The data obtained from aerial photography are directly used as input data. The images in aerial photography don't involve the characteristics like scale, relief and tilt distortions, therefore special aerial photographs such as orthophotographs or orthophotoquads are used for determining the input data. Under these process the point by point correction of scale and relief displacement are carried out.

In remote sensing data input, two major products are derived for input to the GIS, they are digitally enhanced imagery and classified image, digital images are designed to highlight edge features for analysis whereas classified images are designed to replace visual analyst as classifier features. These classified images are obtained from complex computer manipulations which update or compare their classifications with classified data. The images classified from satellite develop accurate result and improve the techniques like insertion of topographic data, preclassified data, rule sets etc.

Q19. Explain the essential components of a remote sensing system.

Answer :

The essential components of a remote sensing system are as follows,

1. Source of uniform energy
2. Non-interfering atmosphere
3. Series of unique energy
4. Super sensor
5. Real-time data handling system
6. Multiple data users.

1. Source of Uniform Energy

The source of uniform energy provides energy on every individual wavelengths in order to produce effective efficiency irrespective of time and place.

2. Non-interfering Atmosphere

The energy from the source is not modified due to non-interfering atmosphere.

3. Series of Unique Energy

The reflected or emitted signals are generated due to the matter interactions at the surface of the earth. These signals are selective corresponding to wavelength and also are in variant and unique to every individual characteristics of the earth surface.

4. Super Sensor

It is a type of sensor which is highly sensitive to all wavelengths that yield spatially detailed information on the absolute brightness from a scene.

5. Real-time Data Handling System

When the radiance Vs wavelength responses over a terrain element is generated in the real-time data handling system, they are processed into an interpretable format and are recognized as unique to a specific terrain element from which they are received.

6. Multiple Data Users

The multiple data users are highly skilled users who possess the knowledge of remote sensing data acquisition and analysis techniques.

Q20. Explain the components of remote sensing with a neat sketch.

[Nov./Dec.-17, (R13), Q4(a) | Model Paper-II, Q2(a)]

Answer :

Various elements of remote sensing are as follows,

1. Sources of energy
2. Radiation and the atmosphere
3. Target interaction
4. Recording energy through sensor
5. Electronic forms like transmission, reception and processing
6. Analyzing and interpretating the data
7. Application of data.

1. Sources of Energy

Remote sensing requires energy to illuminate electromagnetic energy to the target. Such energy for remote sensing is obtained from sunlight.

2. Radiation and the Atmosphere

The remote sensing energy which transfer from its source to the target gets interacted with the atmosphere and reflects the same energy from the target to the sensor.

3. Target Interaction

After receiving the remote sensing energy through atmosphere, it interact with the target based on target and radiation properties.

4. Recording Energy through Sensor

The energy emitted from the target are collected and recorded by electromagnetic radiation sensors.

5. Electronic forms (Transmission, Reception and Processing)

The energy recorded by the sensor are transform to receiving and processing station in electronic form to processed the data into an image (or) hardcopy (or) digital form.

6. Analysing and Interpretating the Data

The data processed into image are analysed visually (or) digitally (or) electronically in order to obtain the information about the target.

7. Application of Data

In remote sensing process, the information about the target obtained from the images are applied for solving a problems, revealing new information and for better understanding of remote sensing process.

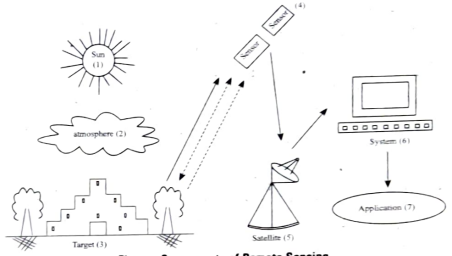


Figure : Components of Remote Sensing

Q21. Explain the procedure of electromagnetic remote sensing.

Answer :

Procedure of Electromagnetic Remote Sensing

Two main processes are involved in electromagnetic remote sensing, they are as follows,

1. Data acquisition
2. Data analysis.

1. Data Acquisition

Various elements are used for acquisition of data, which are as follows,

(i) Source of energy

(ii) Radiation of energy through atmosphere

(iii) Energy interaction

(iv) Recording energy through sensors like air borne, space borne

(v) Generation of sensor data in the form of pictures or digital information.

(i) Sources of Energy

The process of remote sensing requires energy to illuminate electromagnetic energy to the target. Such energy for remote sensing is obtained from sunlight.

(ii) Radiation of Energy through Atmosphere

The remote sensing energy which transfer from its sources to the target gets interacted with the atmosphere and reflects the same energy from target to the sensor.

(iii) Energy Interaction

After receiving the remote sensing energy through atmosphere, it interact with the target based on target and radiation properties.

(iv) Recording Energy through Sensors like Air Borne and Space Borne

The energy emitted from the target are collected and recorded by electromagnetic radiation sensors like air borne (or) space borne.

(v) Generation of Sensor Data

The energy recorded by the sensor are transform to receiving and processing station in electronic form to processed the data into an image (or) hardcopy (or) digital form.

2. **Data Analysis**

The analysis of remote sensing data can be done in two techniques. They are as follows,

(i) Visual image interpretation techniques

(ii) Digital data image techniques.

(i) Visual Image Interpretation Techniques

The analysis of remote sensing data using visual image interpretation techniques involves the fundamental picture elements like texture, pattern, tone name, size and shape for analyzing and identifying different objects. The data obtained in visual interpretation are transfer to base maps using various photogrammetric instruments. Three dimensional images in visual interpretation are obtained by using stereoscopic instruments like aerial or satellite imagery.

(ii) Digital Data Image Techniques

If the data of remote sensing is in digital form then computer system are adopted for analysing such type of data, in order to obtain statistical and thematic information about resources these techniques are used for certain functions such as height extraction, edge detection etc by adopting specialized image processing techniques. The analysis of data using this techniques provide quick result with large volume of data and also the image like geometrical are corrected using digital data technique. The thematic information obtained using modified by means of image classification and provide input data for a GIS system.

Q22. Discuss remote sensing terminology and units.

Answer :

Terminology of Remote Sensing

1. **Analogue :** Analogue refers to things which are not defined in terms of numbers. It is the antonym of digital. For example, photo shot with a film camera would be an analogue picture.
2. **Digital :** Digital refers to things which are defined in terms of numbers. It is the antonym of analogue.
3. **Digital Analysis:** Analysis through digital satellite image involves special computer programs which can stretch and distort a digital image so as to ensure that the image is clearly visible.
4. **Detection :** Detection means to find whether something is there or not through our sensor by using instruments.
5. **Electromagnetic Spectrum:** The energy range that consists of bands like visible, infrared, ultraviolet, microwave, gamma ray etc electromagnetic, spectrum of different bands have different wavelengths and frequencies.
6. **Image :** Image is a picture which is result of the sensing process. It is displayed on the monitor of a computer or its copy is printed.
7. **Enhancement :** When an image is modified so that it becomes more accurate, faster or simpler to analyze and interpret by human eye then it is a form of enhancement.
8. **Image Analysis:** The study of an image in order to explain, map, count, measure or monitor, what is on the earth's surface.
9. **Monitoring :** Monitoring means to track things that changes with respect to time. For example, monitoring the rate at which glacier is melting or how the crops are growing etc.
10. **Orbit :** The path traced by a satellite as it revolves around the plant.
11. **Reflection :** When light or radar signals bounce off the target then reflection takes place. Reflection is very important in remote sensing because its cause and its effect gives lot of information about the target.
12. **Satellite :** A satellite is artificial or natural object that revolves around the earth or any other planet or star. The instrument carried by the remote sensing satellite records images of the earth which are then transmitted to receiving station using radio waves.
13. **RADARSAT :** RADARSAT is a remote sensing satellite that uses radar technology to take pictures of earth's surface. Also, it is the first canadian satellite.
14. **LANPSAT :** LANPSAT is a series of remote sensing satellites to record images of the earth's surface by using infrared and visible bands of a spectrum. It is owned and launched by United States of America.
15. **Platform :** It is the thing which carries the sensor. Remote sensing platform can be a hot air ballon, tall tower satellite or anacroplane.
16. **Sensor :** Sensor is similar to camera that records remote sensing image.
17. **Transmit :** The energy which passes through an object can be termed as transmitted energy. The glass window allows light to transmit so as to see through glass.

18. **Cloud:** When an optical satellite passes over the cloud,the satellite image shows only the clouds and the features below the clouds are not visible. At the surrounding nearby, a cloud shadow is visible which is of the same shape as that of cloud.
19. **Backscattering :** The energy which is scattered back from the same direction where it came from is known as back scattering.
20. **Earth Observation :** To observe earth from air craft and satellites with the help of sensors and taking images of it to study about the objects on or near the earth's surface.
21. **Emit :** Emit means "sent out" or "given off ". As the radiation is emitted by the sun, some amount of it is felt as heat and some other as light.
22. **Line of Sight :** Two objects are said to be in line of sight if they have nothing in between them. In case of satellite and receiving station, if the earth comes in between them, then satellite and receiving station are not said to be in line of sight.
23. **Receiving Station :** The signals sent by an orbiting satellite is collected by antennas at the receiving station. Electronic devices stores the data by processing the signals.
24. **Resolution :** Resolution describe the quality of a picture. If the picture is blurry and small objects are not visible then it means that the resolution is poor. Similarly, if the picture is shart and even small objects are clearly visible then the resolution is good.
25. **Target :** Targets are the features which are studied in a remote sensing image.

Units Used in Remote Sensing

1. **Pixel :** It is the smallest unit of digital image.
2. **Millimeter :** It is the unit in which photographic film is measured.
3. **Micrometer :** It is the smallest unit of bands of electromagnetic spectrum. It is denoted by μm.

Q23. What are the advantages and disadvantages of using remotely sensed data?

Answer : **Model Paper-I, Q3(b)**

Advantages of using Remote Sensed Data

1. Remote sensed data records the satellite images permanently, so that useful information are provided in different wavebands.
2. It provides regional survey of maximum area coverage to identify large features of various themes.
3. Dynamic themes like water, agriculture etc are recorded due to repetitive coverage.
4. Data is easily collected at various scales and resolutions.
5. The data of single remotely sensed image are used for various applications and purposes.
6. Computers are used processing the remotely sensed data fastly.
7. The analysis of remote sensing data is economical, because the images are analyzed in the laboratory itself. Therefore, field work cost is reduced.
8. The revision of map is economical and faster from medium to small scales.
9. Three band images are used for producing color composite because it provide proper details of area than single band image or aerial photograph.
10. For three dimensional studies, stereo satellite data's are adopted.

Disadvantages of using Remotely Sensed Data

1. Remotely sensed data are expensive for one time analysis and small area.
2. Specialized training are needed for analyzing images.
3. It cannot make large scale engineering maps through satellite.
4. Aerial photographs are costly because the study of dynamic features are required when repetitive photographs are used.

Q24. What are the different applications of remote sensing? State its uses.

Answer :

Applications of Remote Sensing

1. Geology and geomorphology mapping
2. Soil classification mapping
3. Land use mapping
4. Forestry and vegetation mapping
5. Agriculture
6. Water resources.

Uses

1. **Geology and Geomorphology Mapping**

(a) Geology

(i) To update the geological maps which exist.

(ii) To identify the favourable features for mineral localisation.

(iii) To prepare reconnaissance maps of inaccessible, unmapped areas.

(iv) Tectonic and lineament maps are prepared rapidly.

(b) Geomorphology

To prepare regional geomorphological maps.

2. **Soil Classification Mapping**

It is used to study surface manifestation and improve the effectiveness of soil surveys.

3. **Land use Mapping**

The spatial distribution knowledge of land use mapping is useful to administrators and regional planners. Remote sensing data is used to achieve up-to-date land use pattern of large areas.

4. **Forestry and Vegetation Mapping**

The remote sensing helps to provide,

(i) Forest hazards detection like disease, fire and excessive felling.

(ii) Idea of forest cover types and give information about the forest cover extent.

5. **Agriculture**

The remote sensing provides the information of area measurement under various types of crops, crop measurement.

6. **Water Resources**

Remote sensing data is useful to provide,

(i) Determination of potential ground water zones.

(ii) Snow cover mapping and run-off prediction.

(iii) Stream pattern and surface water mapping.

(iv) River configuration of pre-flood and post-flood and flood plain mapping.

(v) Irrigated area studies and its monitoring.

1.1.2 Electromagnetic Spectrum, Energy Resources, Energy Interactions with Earth Surface Features and Atmosphere, Atmospheric Effects

Q25. Discuss in detail about the electromagnetic spectrum.

Answer :

Electromagnetic Spectrum

Electromagnetic spectrum is defined as the control of radiations through wavelength, frequency, or energy. It observes energy through earth surface, the major sources of electromagnetic spectrum is sun. The data reflected or emitted from electromagnetic spectrum are recorded through photographic and non-photographic remote sensing system. The frequency of electromagnetic radiation is inversely proportional to its wavelength i.e., low wavelength has high frequency cosmic waves and long wavelength has short frequency waves. The visible region of electromagnetic spectrum is very narrow (i.e., 4.4 – 0.7 μm). In these region aerial photography are adopted for recording the radiations.

The electromagnetic energy observes from sun gets effected while passing from atmosphere to earth. This is because atmosphere contains various aerosol and gas molecules which scatter (or) absorb the electromagnetic energy based on their wavelength. Such scattering of energy changes the direction and intensity of radiations. The scattering of radiations decreases with increase in wavelength of electromagnetic spectrum. If the wavelength of electromagnetic radiation is less than 0.3 μm, then gas molecules like ozone absorbs the radiation completely in the upper part of atmosphere.

The electromagnetic energy gets modified in the earth by interacting with features of earth surface. These modified energy gets reflected, refracted and transmitted again. The object which absorbs such energy will transmit it in the form of emitted energy. The emitted energy reflected from earth surface are observe by remote sensing system. The electromagnetic radiation energy gets reflection depending on the surface roughness and nature of material A rough surface reflect the energy more brighter and diffused than a smoother surface. The energy emitted from earth surface are invisible and can be absorbed through a detector of wavelength of emission region.

Thus cameras or detector's are required for electromagnetic spectrum for recording the reflection or emission of electromagnetic radiation.

Q26. Explain the major divisions of electromagnetic spectrum.

Answer :

(i) Radio

It is the longest wavelength portion of electromagnetic spectrum. In this region the various classified radars operate with very long wavelengths.

(ii) Radar

It is an active form of microwave remote sensing. The image of radar are acquired at different wavelength bands.

(iii) Thermal IR

It has the principal atmospheric windows in 8 to 14 μm thermal region. At this wavelength, the images are acquired by special vidicon systems and mechanical scanners. The microwave wavelengths of 0.1 to 30 cm longer can penetrate into fogs, clouds and rain.

(iv) Reflected IR Band

It is a reflected solar radiation having information about thermal properties of materials. The band of range 0.7 to 0.9 μm is defectable with film and is called the photographic IR band.

(v) Infrared

In this, the interaction with matter differs with wavelength. The atmospheric transmission windows are also separated.

(vi) Visible

It is imaged with film and photodetectors. It also includes reflected energy peak of earth at 0.5 μm.

(vii) Photographic UV Band

It is transmitted through atmosphere. It can defected with film and photodetectors. The atmospheric scattering in this process is serves.

(viii) Ultra Violet

In this, the incoming wavelengths of not more than 0.3 μm are completely absorbed by ozone in upper atmosphere.

Q27. Discuss in detail about the energy source and its characteristics for remote sensing.

Answer :

If the temperature of the objects is greater than zero, they emit radiation. The conversion of main parts of the sun from hydrogen to helium generates energy which is radiated from outer layers. The distribution of energy received at the edge of earth's atmosphere, evenly over the earth gives an average 1367 W/m^2 flux density known as solar constant. The earth reflects back 35 percent of indecent radiant flux which includes energy reflected by atmosphere and clouds. 48 percent of it is absorbed by materials of earth surface and the atmosphere absorbs 17 percent. If the sun emits perfectly, then it would be taken as ideal black body. The transformation of heat energy into radiant energy is carried out by a black body at a suitable rate consistent with Planck's law which describes the black body existence spectrally.

$$M_\lambda = \frac{C_1}{\lambda^5[\exp(C_2/\lambda T)-1]}$$

Where,

λ – Wavelength

M_λ – Spectral existence per unit wavelength

T – Temperature in K

$C_1 = 3.742 \times 10^{-16}\ Wm^{-2}$

The characteristics of radiation sources apply some drawbacks on wavebands range used in remote sensing. Normally, the wavebands are selected based on,

(i) Scattering and atmospheric absorption effects

(ii) The target nature

(ii) The radiation source properties.

Q28. Briefly discuss the following :

(a) Planck's law

(b) Stephen Boltzmann's law

(c) Wein's displacement law.

Answer :

(a) Planck's Law

Planck's law defines the spectral existence of block body and explain the effect of photo electric. In Planck's law, the energy content are inversely proportional to wavelength (i.e., increase in wavelength decreases the energy content). As per Planck's law, the spectral existence per unit wavelength is determined using the equation,

$$M_\lambda = \frac{C_1}{\lambda^5}[\exp(C_2/\lambda T)-1]$$

Where,

M_λ – Spectral existence per unit wavelength

C_1 and C_2 are constants whose value's is equal to 3.742×10^{-6} watts per m^2 and 1.4388×10^{-2} m°K respectively.

λ – Wavelength (μm)

T – Temperature (Kelvin)

(b) Stephen Boltzmann's Law

Stephen Boltzmann's law explains the property that the amount of energy radiated by any object is a function of surface temperature of the object. He states that continuous Electro Magnetic Radiations (EMR) are emitted when the particle has an absolute temperature of 0 K or 273°C. In Stephen Boltzmann's law, the energy content is directly proportional to temperature (i.e., increase in temperature increases the amount of energy to be emitted). In order to determine the total radiant existence from the surface of the materials Boltzmann used an equation,

$$M = \sigma T^4$$

Where,

M – Total radiant existence from the surface of material (Wm^{-2})

σ – Stephen's constant ($5.6697 \times 10^{-8}\ Wm^{-2}K^{-4}$)

T – Absolute temperature (K).

(c) Wein's Displacement Law

Wein's displacement law relates the temperature with wavelength of maximum spectral radiant existence [At this wavelength, a black body radiation curve reaches maximum value]. It is related with the equation given below,

$$\lambda_m = A/T$$

Where,

λ_m – Wavelength of maximum spectral radient existence (μm)

T – Temperature (K)

$A = 2898$ (μmK)

Q29. Explain the phenomenon of energy interactions with earth's surface materials.

[May-19, (R16), Q5(b) | Model Pepar-II, Q2(b)]

OR

Describe interaction of radiation with the earth surface features.

Nov./Dec.-16, (R13), Q5(b)

Answer :

Energy Interaction with Earth Surface Features

The principle of conservation of energy has given the basic interactions with earth features, when the electromagnetic energy is incident on the earth surface. The equation is as follows,

$$E_I(\lambda) = E_R(\lambda) + E_A(\lambda) + E_T(\lambda)$$

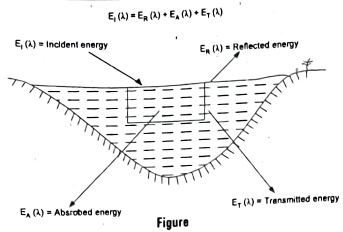
Where,

$E_I(\lambda)$ – Electromagnetic Energy incident on earth surface.

$E_R(\lambda)$ – Radiated energy (on reflected energy)

$E_A(\lambda)$ – Energy absorbed

$E_T(\lambda)$ – Energy transmitted.



Figure

Therefore, the reflected energy in remote sensing $E_R(\lambda)$ is given as,

$$E_R(\lambda) = E_I(\lambda) - [E_A(\lambda) + E_T(\lambda)]$$

Dividing both sides with $E_I(\lambda)$

$$\frac{E_R(\lambda)}{E_I(\lambda)} = \frac{E_I(\lambda)}{E_I(\lambda)} - \left[\frac{E_A(\lambda)}{E_I(\lambda)} + \frac{E_T(\lambda)}{E_I(\lambda)}\right] \quad \ldots (1)$$

Since,

$\frac{E_R(\lambda)}{E_I(\lambda)}$ = Reflectance i.e., $\rho(\lambda)$

$\frac{E_A(\lambda)}{E_I(\lambda)}$ = Absorbance = $\alpha(\lambda)$

$\frac{E_T(\lambda)}{E_I(\lambda)}$ = Transmittance = $\gamma(\lambda)$

$\therefore$ The equation (1) can be written as,

$$\rho(\lambda) = 1 - [\alpha(\lambda) + \gamma(\lambda)] \quad \ldots (2)$$

As the earth features are less transmitting, therefore neglection the transmittance term i.e., $\gamma(\lambda)$ and Kirchoff's law of physics takes the absorbance term [i.e., $\alpha(\lambda)$] as emissivity (ξ).

$\therefore$ The equation (2) becomes,

$\rho(\lambda) = 1 - \xi(\lambda)$

If $\xi(\lambda) = 0$,

Then $\rho(\lambda) = 1$, and

$\xi_I(\lambda) = \xi_R(\lambda)$

Example: Snow

When $\xi(\lambda) = 1$,

Then $\rho(\lambda) = 0$

Example: Black body like lamp smoke.

Q30. Explain briefly about the atmospheric interactions with electromagnetic radiation.

Answer :

The electromagnetic radiation is detected by a remote sensor. This radiation has to pass through the atmosphere, before and after its interaction. This passage will change the intensity, direction of radiation, speed, frequency and spectral distribution. This results in atmospheric scattering and absorption. In visible and infrared wavelengths, these effects are highly severe.

When the energy transmission takes place through the atmosphere, the interaction of light with gases takes place and particulate matter in atmospheric scattering process. Selective scattering and nonselective scattering are the two major processes in scattering. The selective type scattering are Rayleigh, Raman and Mie. Non selective scattering is produced by particles which have more than 10 μm radii such as ice fragments and water droplets. The contrast of the image is reduced by this type of scattering. During passage through atmosphere, the electromagnetic radiations is absorbed by particulates and gases. Besides oxygen and molecular nitrogen, other constituents like hydrogen, methane, helium, nitrogen compounds, water vapour play a vital role in modifying reflected radiation and incident radiation. By this, the image contrast reduces and radiometric errors are introduced. The electromagnetic spectrum regions with a transparent atmosphere are called atmospheric windows.

Q31. What are the types of scattering? Explain.

Answer : [April/May-18, (R13), Q4(a) | Model Paper-III, Q2(a)]

Scattering

Scattering is defined as the changeable diffusion of radiation in atmosphere through particles. The diffusion of electromagnetic energy is carried out by suspended particles in atmosphere. Scattering are classified into two types they are,

1. Selective scattering, and
2. Non-selective scattering.

Selective Scattering

Selective scattering are classified into three types, which are as follows :

(i) Rayleigh's scattering
(ii) Mie's and
(iii) Raman's selective scattering

(i) Rayleigh's scattering

Rayleigh's scattering is also known as clear atmosphere scattering. It takes place in the upper part of atmosphere when the radiations interacts with the atmospheric and small dust particles. In Rayleigh's scattering, the diameter of particle is smaller than the wavelength of interacting radiations. Rayleigh's scattering is inversely proportional to wavelength (i.e., the particle has maximum probability to undergo Rayleigh's scattering with shorter wavelength). Rayleigh's scattering easily explains the concept of blue sky.

$$\text{Rayleigh scatter} \propto \frac{1}{\lambda^4}$$

Where,

λ – Wavelength (μm).

(ii) Mie's Scattering

Mie's scattering takes place at the lower part of atmosphere (i.e., from 0 to 5 km). These scattering are caused due to the particles of water vapour, pollen grains and dust. In Mie's scattering, the diameter of particle has the same wavelength of the radiations observed. In visible region, longer wavelengths and electromagnetic radiations are effected by Mie's scattering.

(iii) Raman's Scattering

Raman's scattering are caused due to the atmospheric particles like gaseous, water droplets and fumes, which has larger, smaller, (or) equal wavelength that of the radiations observed. Under Raman's scatteripg, the energy is either observed or transmitted with increase or decrease wavelength, this is because, these portions have an elastic collision with the atmospheric particles.

2. Non-Selective Scattering

Non selective scattering is produced by particles which have more than 10 μm radii such as ice fragments and water droplets. The contrast of the image is reduced by this type of scattering. During passage through atmosphere, the electromagnetic radiations are absorbed by particulates and gases. Besides oxygen and molecular nitrogen, other constituents like hydrogen, methane, helium, nitrogen compounds, water vapour play a vital role in modifying reflected radiation and incident radiation. By this, the image contrast reduces and radiometric errors are introduced.

Q32. Explain the spectral reflectance signature.

Answer :

Spectral Reflectance Signature

Reflectance is defined as the ratio of energy of the wavelength reflected from the object [$E_R(\lambda)$] to the energy of wavelength incident on the object [$E_I(\lambda)$]. Such reflectance of object with respect to wavelength are termed as spectral reflectance. Spectral reflectance are common for each and every object. The reflectance of the object is given by the equation

$$\rho_\lambda = \frac{E_R(\lambda)}{E_I(\lambda)}$$

Where,

ρ_λ – Reflectance of the object (%)

$E_R(\lambda)$ – Energy of wavelength reflected from the object

$E_I(\lambda)$ – Energy of wavelength incident on the object

λ – Wavelength (μm).

Energy gets transmitted, absorbed or reflected, when the solar radiations collide with the target surface. Such that various materials (or objects reflects and absorbs differently at different wavelengths (this is because the amount of solar radiations reflects, absorbs or transmits changes with wavelength). The reflectance spectrum of a material are drawn with fraction of radiation reflected and the incident of wavelength. These reflectance act as a common signature for each materials. In general, the spectral reflectance signature identifies material with different substances and separate them with other materials.

Under multi-spectral remote sensing, more than two wavelengths are adopted for identifying materials with more separations from other materials.

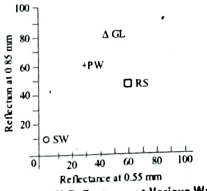


Figure: Showing the % Reflectance at Various Wavelength

Where,

GL – Grass land
PW – Pine wood
RS – Red sand
SW – Silty water.

Q33. What are the different effects of atmosphere on spectral response?

Answer :

Effects of Atmosphere on Spectral Response

Following are the various effects of atmosphere on spectral response,

1. The energy illuminating the ground surface are minimized through atmosphere.
2. The path radiance are added to the signals observe by the sensors through atmosphere.

The effect of atmosphere on spectral response are shown in the flowchart is given below.

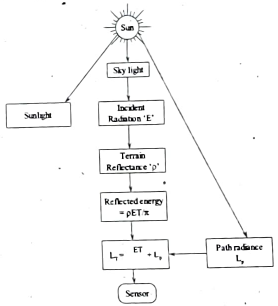


Figure: Showing the Effect of Atmosphere on Spectral Response

Where,

L_p – Path radiance
E – Irradiance on the object
T – Energy transmitted by atmosphere
ρ – Terrain reflectance
L_T – Total spectral irradiance.

1.2 Satellite Orbits, Sensor Resolution, Types of Sensors, Remote Sensing Platforms and Sensor, IRS Satellites

Q34. What is a satellite? How are satellites classified?

Answer :

Satellite

The earth and solar systems are observed by using satellites. It is also used to observe oceans, earth's atmosphere and surface.

Classification of Satellites

The satellites are classified as follows,

1. Based on the purpose
2. Based on the orbit around which they revolve.

1. Based on the Purpose

(i) Communication satellite
(ii) Earth resources satellite
(iii) Spy satellite
(iv) Weather satellite.

2. Based on the Orbit around which they Revolve

(i) Geostationary orbit satellites
(ii) Inclined orbit satellites
(iii) Polar orbiting satellites
(iv) Molniya orbits.

Q35. Explain the following satellites,

(i) Sun synchronous satellites
(ii) Geostationary satellites
(iii) Polar orbiting satellites
(iv) Earth resources satellites.

Answer : Model Pepar-III, Q2(b)

(i) Sun Synchronous Satellites

The location of sun synchronous satellites is at very lower altitudes, normally a few hundred or thousand kilometers from earth surface. There is a special case of polar orbits in which they rotate. The travelling of these satellites is from north pole to south pole as the earth turns below it. Sun synchronous satellites pass once the same part of earth each day at the same local time making a collection of different forms of data and communication more easy.

(ii) Geostationary Satellites

At an elevation of 35790 km, geostationary satellites orbit because the orbital period produced by it is equal to the earths rotation period. A bigger view of the earth is provided by these satellites. Therefore it provides facility of covering weather events.

(iii) Polar Orbiting Satellites

These satellites orbit at a height of 700 to 800 km near polar inclination. They cover the difficult parts such as Antarctica. Passing of these satellites through latitude and equator is at the same time and enables regular data collection and providing facility of long term compromises.

(iv) Earth Resources Satellites

These satellites are sun synchronous satellites used for observing and accessing the resources of earth. The objective of these satellites is to provide multispectral images for proper information of earth's resources, change in environment, effects of human activities.

Q36. What are the various orbits in which satellite can exist? Discuss.

Answer :

Satellite orbits are defined as the specific paths in which satellite will revolve around the earth. It is not fixed that the earth should have only one satellite. These satellites have their own specific paths called orbit paths and these orbits are placed around the earth with a fixed small radius or large radius depending on the functioning of the satellite. By this it is clear that different types of orbits exist. The various types of orbits used in satellite communication are,

1. Low earth orbit [LEO]
2. Medium earth orbit [MEO]
3. High earth orbit [HEO]
4. Geosynchronous orbit [GEO]

1. Low Earth Orbit [LEO]

An orbit whose limits are between 750 km and 1500 km i.e., upper orbit altitude 1500 km and lower orbit altitude –750 km is known as low earth orbit. It is abbreviated as LEO.

The power required for the satellite to orbit in LEO is low. Since propagation delay is directly related to orbital height, it is also low for LEO.

2. Medium Earth Orbit [MEO]

The abbreviation 'MEO' stands for medium earth orbit. The orbital height of MEO is limited between 1500 km and 36000 km i.e., lower orbit altitude is at 1500 km and upper orbit altitude is at 36000 km. It is used in navigation applications and propagation delay due to this is moderate.

3. Geosynchronous Orbit [GEO]

'GEO' stands for geostationary orbit. It is an orbit with circular shape. In other words, the orbit with zero inclination and eccentricity. The height of geo sationary orbit is 35,786 km.

4. High Earth Orbit [HEO]

The full form of 'HEO' is highly elliptical orbit. It is an elliptical orbit Characterized by a low altitude perigee and a quite high altitude apogee. Dwelling (staying) at a point in the sky for a long time is a benefit for these elongated orbits during the approach and descent from apogee.

Examples

Molniya orbit, Tundra orbit.

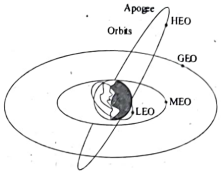


Figure: Representing Four Types of Orbits

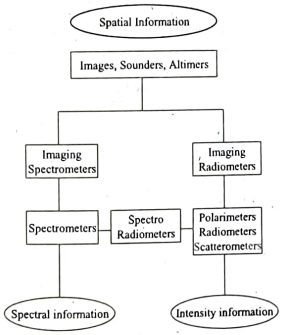
Q37. What are sensors? How are the sensors classified based on their functions?

Answer :

Sensors

The remote sensing instruments designed to calculate the photons are known as sensors. The charged plates are the detectors in the sensors which are made up of height sensitive material. When sensors are subjected to beam of photons, electrons are emitted. The reflected EMR from the objects are recorded by sensors. The radiations are converted into electrical signals by these sensors.

Classification of Sensors based on their Functions



Figure

Q38. What are the types of resolution involved in Remote Sensing? Explain.

[April/May-18, (R13), Q5(a) | Model Pepar-II, Q3(a)]

OR

Explain briefly the types of Resolutions of a Sensor used in Remote sensing.

Answer : Nov./Dec.-17, (R13), Q5(a)

Various parameters of sensors are as follows,

1. Spatial resolution
2. Spectral resolution
3. Radiometric resolution
4. Temporal resolution.

1. Spatial Resolution

Spatial resolution is defined as the detection of minimum amount of change in spectral through sensors. In spatial resolution, object size are limited through pixel size. (i.e., the object cannot be make smaller than the pixel size) ground surface area are measured by single detector element in given short period, in order to determine the intrinsic resolution of imaging system through Instantaneous Field of View (IFOV). If the object is effect with the factors like improper focusing, atmospheric scattering and target motion results to decrease the intrinsic resolution of imaging system. Fine features are observed in the image using "high resolution" image with small pixel size. Whereas, the coarse features are observed in the image through "low resolution" image with large pixel size.

2. Spectral Resolution

Spectral resolution is defined as shortest area detected on the ground by a detector placed on a sensor. Bandwidths of electromagnetic radiations are used for determining the spectral resolution of sensors. Narrow width of bandwidths develop high spectral resolution compare to broad width of bandwidths. They provide accurate spectral signature for smaller objects.

3. Radiometric Resolution

Radiometric resolution is defined as the detection of minimum change in intensity through sensing system, based on signal to noise ratio of detector. The radiometric resolution in a digital image are restricted by number of discrete quantization levels. These discrete quantization level continuously decrease the intensity value.

4. Temporal Resolution

Temporal resolution is the smallest period, in which repetitive coverage of ground area are observed through remote sensing system.

Q39. List the Indian Satellite and Sensor resolution characteristics.

Answer : Nov./Dec.-17, (R13), Q5(b)

Satellite Name	Cartosat-2 F	Cartosat-2E	Cartosat - 2D	Resource Sat - 2A
Full Name	Cartosat -2F	Cartosat-2E	Cartosat - 2D	Satellite for earth resources - 2A
Satellite Description	8th flight unit of the cartosat progamme	7th flight unit of the cartosat programme.	6th flight unit of the cartosat programme.	3rd flight unit of resource sat programme.
Launch Date	Jan.-12th 2018	June 23, 2017.	February 15, 2017.	December 7, 2016.
Launch Vehicle	PSLV - C40	PSLV - C38	PSLV - C37	PSLV - C36
Orbit	Sunsynchronous polar orbit.	Sunsynchronous orbit.	Sunsynchronous orbit.	Sunsynchronous orbit.
Mass	710 kg	712 kg	714 kg	1206 kg (Dry mass)
Power	986 watts.	986 watts	986 watts	1250 watts
Altitude	505 km	505 km	505 km	817 km
Main Mission	Earth observation	Land observation	Land observation	Land observation

Q40. What are the different platforms that are used in remote sensing?

Answer :

Based on the objects under study on the surface of the earth are classified into two types.

1. Air borne platforms
2. Space borne platforms.

1. Air Borne Platforms

The air borne platforms comprise of balloons and aircrafts.

(i) Balloons

(a) The meteorological factors like velocity of wind and direction limits the utilization of balloons.

(b) They are commonly applied in resource mapping.

(c) Balloons cover a large range of altitudes for remote sensing measurements in the stratosphere.

(d) The instruments for balloons provide an opportunity for extra correlative information that depends on satellite.

(ii) Aircrafts

(a) The aircrafts are used for obtaining the aerial photographs.

(b) Aircrafts can fly at relatively low altitudes.

(c) Aircrafts can easily alter the scheduling for avoiding weather problems like clouds that block the view of the ground for passive sensor.

(d) The maintenance of sensor, repair and alteration in configuration can be easily made to platforms of aircraft.

(e) They are also helpful in large-scale mapping and regional coverage.

2. Space Borne Platforms

(a) In space borne remote sensing, sensors are mounted on spacecraft orbiting the earth.

(b) Space borne platforms comprise of the rockets, satellites and space shuttles.

(c) These platforms range between 100 to 36000 km above the surface of the earth.

(d) These platforms are useful in resource mapping, meteorological and communication applications.

Q41. What do you mean by IRS? Give Examples.

Answer : April/May-18, (R13), Q1(d)

IRS

IRS is an acronym for Indian Remote Sensing Satellite. It is a satellite based remote sensing system, designed to extract the information on natural resources. The principal components used in the planning and implementation of IRS are as follows.

(i) A three axis stabilised polar sunsynchronous satellite with multispectral sensors

(ii) Data reception on ground

(iii) Multispectral data recording and processing

(iv) Ground systems for controlling in-orbit satellite and for tacking supporting system information.

(v) Hardware and software components and their analysis.

The Indian remote sensing satellites in the order of their launch are,

IRS–1A,	IRS–1B,	IRS–P1,	IRS–P2,	IRS–1C
IRS–P3,	IRS–1D,	Oceansat–1,	TES,	ResourceSat–1
Cartosat–1,	Cartosat–2,	Cartosat–2A,	IMS–1,	Oceansat–2,
Cartosat–2B,	ResourceSat–2,	Megha–Tropiques,	RISAT–1,	SARAL

Here,

IRS – Indian Remote Sensing

Cartosat – Cartography Satellite

IMS – Indian Mini Satellite

RISAT – Radar Imaging Satellite

SARAL – Satellite with Argos and Altika.

Q42. Write in brief about the sensor characteristics of:

(a) IRS satellite.

(b) LANDSAT.

Answer : Model Pepar-II, Q3(b)

(a) IRS Satellite

IRS stands for Indian Remote sensing satellite. The future desirable event of IRS mission is the evaluation of natural resources by planning and implementation of satellite based system of remote sensing. The components of IRS mission are:

1. A polar sun synchronous satellite stabilised in three axis with multispectral sensors.
2. Data reception based on ground
3. Systems of recording and processing for multispectral data.
4. System of ground for the control of inorbit satellite, which includes network tracking with the supporting systems associated.
5. Elements of software and hardware for user oriented data products generation.
6. Analysis of data and archieving.

The series of IRS satellites are IRS IA, IRS IB, IRS IC, IRS ID and IRS PY. IRS IA and IRS IB has same orbital and sensor characteristics. IRS IC and IRS ID also have similar characteristics while, IRS PY is an oceanographic satellite.

Satellite Characteristics	
Orbit	: Near-polar, Sun-synchronous
Altitude	: 904 km
Inclination	: 99.03°
Equatorial Crossing Time	: 10.00 Hours
Eccentricity	: 0.002
Period	: 103 min

Capabilities of Sensor Linear Image Scanning System : LISS		
Number of LISS Cameras	LRS (1)	MRC (2)
Number of Spectral Bands	4	4
IFOV (Microrad)	80	40
Geometric Resolution	72.5	36.25
Swath width	148 km	74 km
Radiometric Resolution	7 bits	7 bits
Band–to–Band	0.5	0.5

Applications of IRS satellite

1. Agricultural resources management
2. Forest resources inventory
3. Geological mapping
4. Water resources estimation
5. Quality water surveying

(b) LANDSAT

A series of Earth Resources Technology satellites (ERTS), were planned to launch by National Aeronautics and Space Administration (NASA) of USA in collaboration with U.S Department of interior. On July 23, 1972 ERTS – 1 was lanuched by a Thor Delta rocket, operated till January 6, 1978, which represented as the design of first unmanned satellite for acquiring data of earth resources based on a systematic, medium resolution, repetitive and multispectral bands. This ERTS was renamed as 'Landsat' programmed by NASA to differentiate it from the series of oceanographic and meterological satellites launched by USA later. ERTS – 1 was renamed as Landsat – 1. Fire series of landsat satellites have been launched till today. Landsat programme has evolved as a global resource monitoring programme. Three types of sensors such as Return Beam vidicon (RBV) camera system, the Multispectral Scanner (MSS) system and the Thematic Mapper (TM) are used.

Capabilities of Satellite		
Particulars	Landsat – 1 to 3	Landsat – 4 and 5
Altitude	919 km	705 km
Orbit	Near–Polar	Near–Polar
	Sun–Synchronous	Sun–Synchronous
Inclination	99.09°	98.2°
Period	103 minutes	99 minutes
Equatorial	0930 hrs	0945 hrs
Crossing time	18 days	16 days
Repeat cycle Swath width	185 km	185 km
Data speed	15.06 Mbps	84.9 Mbps

Capabilities of Sensors

Sensor	Mission	Channel	Spectral Spatial Resolution in Microns	Spatial Resolution	Radiometric Resolution
RBV	Landsat 1 to 3	1	0.475 – 0.575	80 m	6 bits
		2	0.580 – 0.680	80 m	(127 levels)
		3	0.690 – 0.830	80 m	
		4	0.505 – 0.750	80 m	
MSS	Landsat 1 to 5	1	0.5 – 0.6	79/82 m*	
		2	0.6 – 0.7	79/82 m*	6 bits
		3	0.7 – 0.8	79/82 m*	(127 levels)
		4	0.8 – 1.1	79/82 m*	
		5	10.4 – 12.6	240 m	
TM	Landsat 4 to 5	1	0.45 – 0.52	30 m	
		2	0.52 – 0.60	30 m	
		3	0.63 – 0.69	30 m	8 bits
		4	0.76 – 0.9	30 m	(255 levels)
		5	1.55 – 1.75	30 m	
		6	2.08 – 2.35	30 m	
		7	10.4 – 12.5	120 m	
For Landsat – 1, 2 and 3 spatial resolution is 79 m and 82 m for Landsat 4 and 5					

Applications of LANDSAT

1. Used in agriculture, botany, cartography, civil engineering, environmental monitoring, forestry, geography.
2. Used for planning of landuse
3. Analysis of quality water.

1.3 Remote Sensing Data Interpretation

1.3.1 Visual Interpretation Techniques, Basic Elements, Converging Evidence, Interpretation for Terrain Evaluation, Spectral Properties of Soil, Water and Vegetation

Q43. What is visual interpretation? What are the basic elements to be considered during visual interpretation of satellite images?

OR

Write in detail the basic elements of visual interpretation techniques with suitable examples.

Answer : May-19 (R16), Q4

Visual Interpretation

Visual interpretation is defined as the process of analysing satellite images, in order to identify and estimate the importance of object. Under aerial (or) satellite image conditions, visual image interpretation involves purposes like detection, recognition, classification, identification and delineation of objects.

The basic elements to be considered during visual interpretation of satellite images are as follows,

1. Tone
2. Shape
3. Size
4. Texture
5. Pattern
6. Shadow and
7. Association.

1. Tone

Tone in satellite imageries is referred to brightness or colour of an object. It acts as a fundamental element for differentiating targets in an image.

2. Shape

Shape is generally referred to structure (or) outline of each object. Basically irregular shapes represent forest, whereas urban (or) agricultural fields are represented as straight edge shapes.

3. Size

Size is a function of scale. The absolute size of target supports in interpretation. Therefore, it is important to determine the size of target compared to other objects in the segment.

4. Texture

The arrangement and frequency of tonal variation in specific areas of image is referred as texture. Texture is of two types, they are,

(i) Rough texture and

(ii) Smooth texture.

Under rough texture grey levels vary suddenly into small areas, and in smooth texture, very less tonal variations are observed. The examples for smooth and rough textures are grasslands and forest canopy respectively.

5. Pattern

Pattern is defined as the spatial arrangement of visible discernible objects. It is produced when similar texture is repeated orderly. Orchards with evenly spaced trees is the best example for pattern.

6. Shadow

For better identification of target, shadows are used. This is because, shadow provides an ideal profile and relative height of a target. Targets within shadows are less discernible than their surroundings.

7. Association

Association develops a relationship between observable objects and proximity of the target. Commercial property associated with proximity of major transportation route is an example of association.

Q44. What are the Instruments used for visual image interpretation and transfer of data?

Answer :

The instruments used for visual image interpretation and transfer of data are:

(a) Aerial photographs

(b) Satellite single band imageries

(c) False colour composites.

(a) Aerial Photographs

In aerial photo, the image is interpreted by using the features of the image of earth's surface such as tone, colour, shadow, texture, shape and size, and also by using certain ground features such as land form, vegetation, land use, drainage, erosion and lineaments.

(b) Satellite Single Band Imageries

In satellite imagery process, there are two possibilities for interpretation as it is available in both graphic forms and digital form. The technique used in aerial photograph is applied in graphical form. For the imagery on different bands, a special emphasis has to be applied because of very small scale of imagery (i.e., 1.1 million or so). These are used in areas such as natural hazards, flooding, landslide, earthquakes etc., and also used in forestry and vegetation studies.

(c) False Colour Composites

A group of colour rendering methods utilized to display images in colour is known as false color. The visual interpretation of the remote sensing data depends on false colour composites.

Q45. Explain the different applications of aerial photo interpretation.

Answer : Model Pepar-III, Q3(a)

Applications of Aerial Photo Interpretation

Following are the areas where aerial photo interpretation are broadly used,

1. Topographical Mapping

In topographical mapping, aerial photographs are used for overlap between two successive photos in forward and lateral directions. Forward direction is the direction of aircraft flight with a minimum forward overlap of 60 percent. The lateral overlap varies from 25 to 30 percent at right angle to the forward direction. This overlap photos are arranged in stereo projectors such that the ground models are reproduce and user/observer determines the three-dimensional view of the ground.

2. Geology

An aerial photographs in the geological mapping include both surface and sub-surface mapping for mineral and other geophysical exploration. The aerial photograph provide a synoptic view of terrain (bird eye view) from a given height. Higher the height of terrain (from where the photo is taken) greater is the synoptic view.

The principle of aerial photo interpretation are used for carrying out the geological mapping like resistance to erosion, rock type boundaries, outcrop boundaries, topographic expression, drainage pattern, lineament pattern, vegetation cover, joints and faults along with their patterns.

3. Soil Mapping

Soils are derived from rocks, and the surface features of soil mapping are different when compare with forest, geology and other mappings, therefore direct mapping is not possible. A photo is used for preparing base map in which ground information is entered and the relation between type of soil, tone and texture are identified on aerial photograph. These photos under stereoscope provide 3-dimensional view to the observer. The factors of soil type mapping like soil moisture, soil texture, surface roughness, presence of iron oxide and organic matter content are identified through aerial photograph in soil mapping.

4. Forest Area

Aerial photograph interpretation are used by forestry to achieve the following applications.

(i) Preparation of base map

(ii) Identification of tree species

(iii) Quantitative measurements of density, height, crown shapes and volume of trees.

Terrain Evaluation

5. For answer refer Unit-II, Q48.

Land Cover (or) Land Use Mapping

6. The term land cover refer to the type of feature available on the surface of earth. And land use is related to the human activity associated with a specific piece of land. Aerial photograph easily delineated the types of land use/ Land cover. This photos are observe under stereoscopic vision. The resolution are identified based upon the scale of photos adopted (larger the scale of photo greater is their resolution). Generally in land use/ land cover mapping a large scale of 1:10,000 to 1:5000 are provided. Colour photos are also used which enhance the features and provide more information.

7. Agricultural Area

Aerial photograph interpretation in agriculture are applied in three major areas which are,

(i) Crop condition assessment

(ii) Classification of crop type and

(iii) Estimation of crop yield.

The steps of photo interpretation involved in agricultural studies are related to estimation of drainage pattern and analysis, photo tones, texture, vegetative features and their patterns.

8. Water Resources

The application of aerial photo interpretation in water resources involve two types, they are,

(i) Mapping surface water bodies and

(ii) Mapping ground water potential.

Water bodies like streams, rivers, lakes etc., are easily identified on the aerial photos. It also identifies the location of ground water and indicate the presence of topography, vegetations, springs, wells and other seepages. Present aerial photo interpretation technique are unable to determine the depth of ground water.

9. Environmental Studies

In environmental studies, aerial photo interpretation are applied for studying the causes of water pollution, deforestation, industrial pollution and denudation. This pollutions are observe on aerial photos and delineated through various tones and textures. Aerial photo interpretation technique are also used for measuring and preventing flood damage by taking aerial photos before and after flood.

Q46. Explain the various interpretation techniques.

Answer :

Interpretation Technique

Following are the various interpretation technique used in geographic information system:

1. Two-dimensional technique
2. Three-dimensional technique
3. Two-dimensional planimetric view
4. Three-dimensional perspective view and
5. Animation method.

1. Two-dimensional Technique

Two-dimensional technique are adopted for interpretating the relationship between two numerical variables like line graph and scatter plot. It is also used for producing multivariate view of many data sets like parallel co-ordiante plot.

2. Three-dimensional Technique

Three-dimensional technique is also known as surface technique, It is adopted for interpretating the relationship among three numerical variables like percentage of reflectance, number of columns and number of rows.

3. Two-dimensional Planimetric View

Two-dimensional planimetric view technique are adopted in conventional cartographic interpretation, where the spatial variation and patterns producing from data analysis are effectively represented using various colors and symbology.

4. Three-dimensional Perspective View

Three-dimensional perspective view technique are generated in number of ways like geometric modeling, video imaging, geometric video imaging and image dropping etc. This technique is created in geometric modeling for observing simple three dimensional perspective drawings at a range of landscape to relative complex wireframe models. Photo realistic quality view is produce in video imaging which depict the conditions of landscape. In geometric video imaging, geometric modeling and video-imaging techniques are combined in order to depict small changes and high image quality. Draping of image include digital orthophoto in three dimensional prospective view produce by geometric modeling.

5. Animation Method

Animation is a computer graphics method for interpretating time-dependent spatial data. In this method, two dimensional planimetric view technique are adopted for interpretating the changes of spatial data. This technique uses animation sequence like virtual world for moving and observing any part of animated scene.

Q47. Explain briefly about concept of converging evidence?

Answer :

The information about terrain can be derived by interpreting visual images of aerial or space through identification, evaluation, analysis of key elements such as erosion, vegetation, land use etc. The information obtained from key element can be converged and all the evidences of image element identification is combined together for drawing the inferences which are useful for GIS data input, manipulation and analysis.

Convergence evidence is defined as the process of converging the description of all the interpreted results of key elements.

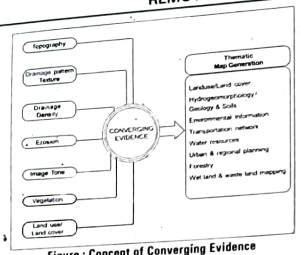


Figure : Concept of Converging Evidence

The process of converging evidence is used by the interpreter to increase the accuracy and details of the visual interpretation results. In general, the key elements mentioned in the figure are widely used for any type of application. But for specific type some of the other key elements are derived from these fundamental key elements.

Q48. Explain briefly about the terrain evaluation.

Answer :

The study of terrain is necessary and an initiative for suitable planning and analysing of land resources. The various purposes are ground water exploration, availability of construction material, requirement of short term military for some of the localized zones, mineral resources development and exploration etc. The collection of maximum and systematic information on different aspects of the ground is the objective of terrain study, so that the necessities of various users are fulfilled by suitable evaluation of this information.

Pattern and facet are the two important units in the classification of terrain. In classification, facet is the fundamental unit, it possesses uniform physical properties for practical purposes. The classification of facet is based on surficial deposits nature, surface and subsurface water region, surface configurations, land use and its associations. The area of commonly occurring topography pattern and surficial deposits is known as landscape pattern. The recognition of landscape pattern is based on topography, geologic setup and climate.

Q49. Discuss spectral properties of soil, water and vegetation?

Answer :

The reflectance percentage of the water starts from zero at 0.4 μm wavelength and peaks near 0.6 μm wavelength, again becomes zero near 0.8 μm wavelength.

The reflectance percentage of the soil increases with increases in the wavelength upto 1.3 μm and from thereon it undergoes small peak and valley configuration.

Spectral reflectance curves for healthy green vegetation is the manifestation of peak and valley configuration. The pigments in leaves of a plant represents valleys in visible region of spectrum. For example: The energy absorbed by the chlorophyll is very strong in the wavelength bands that ranges from 0.45 μm to 0.67 μm. Also, if the wavelength is about 0.7 μm then the reflectance of healthy vegetation increases in a dramatic manner. Within the range 0.7 to 1.3 μm, 40 to 50 percent of the energy absorbed by the leaves of a plant is reflected back and it depends on the internal structure of plant leaves. As the structure is highly variables among plant species, even if the plant species looks same in visible wavelengths, the reflectance measurements can easily differentiate them.

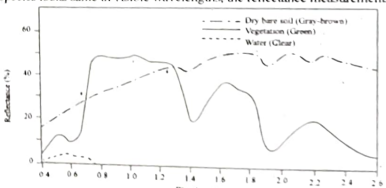


Figure : Spectral Reflectance Curves

1.3.2 Concepts of Digital Image Processing, Image Enhancements, Qualitative & Quantitative Analysis and Pattern Recognition, Classification Techniques and Accuracy Estimation

Q50. Write a note on digital image processing?

Answer :

The application of algorithms on digital images to perform processing, analysis and extracting the information is known as digital image processing. Generally, the data sensed in remote sensing is of digital type, therefore the data processing in remote sensing is considered as digital image processing. Initially the imaging sensors transfer raw data which containing flaws and deficiencies. Later, these flaws and deficiencies gets removed as the images are allowed to undergo various steps of processing. Thereby, the original data is obtained and from that the required information can be extracted from the image. This may not be same for all the images. It may vary from image to image and that depends on the type of image format, initial condition of the image, composition of the image scene and information of interest. The ultimate goal of digital image processing is to obtain the originality of data.

The three major technologies developed in the field of modern remote sensing are,

1. The development of sophisticated electro-optical sensors.
2. The development of high power computer hardware.
3. The processing or data analysis by versatile computer based software programs.

To process remote sensing imagery digitally, the data should be recorded digitally. By using film scanner, the data which is recorded on photographic film can also be converted into digital form but limited computer processing techniques can be applied on it. Therefore, a computer system is preferred for digital image processing as the data can be recorded digitally and stored in a digital data storage devices like hard-disk, CD, DVD etc., Several software systems have particularly developed for better processing and analysis of remotely sensed images.

Q51. Explain basic character of digital image data.

Answer :

The basic character of digital image are as follows,

(i) Original 200 × 200 digital image

(ii) Enlargement indicating 20 × 20 of pixels

(iii) Enlargement indicating 10 × 10 of pixels

(iv) Digital numbers corresponding to radiance of each pixel.

Image (a) consists of two-dimensional array of discrete picture elements or pixels with 200 × 200 and appears to be a continuous tone photograph. Each pixel has an intensity which corresponds to the average radiance measured electronically above the ground area in each pixel. It is impossible to perceive the individual pixels in image (a) but in image (b) they are easily observable in the enlargements indicating 20 × 20 of pixels. These enlargements are then included in image (c). Image (d) indicates the individual digital number which corresponds to the average radiance measured above the ground area in each pixel. An analog-to-digital conversion process is used for quantizing the original electrical signal from the sensor into positive integer values.

(a) (b) (c)

10	9	20	25	26	34	35	11	20	25	31	32	35	36	28
76	34	11	15	41	42	77	14	30	24	22	11	16	69	70
47	25	13	11	10	55	41	39	42	65	27	79	18	20	35
42	19	15	19	22	52	71	56	34	35	41	50	55	11	38
34	20	16	60	27	85	35	17	25	16	10	31	52	13	40
25	30	29	23	18	49	38	78	19	29	18	26	85	12	41
30	42	20	13	57	23	73	74	60	20	57	63	82	19	71
19	60	45	28	40	11	79	32	48	45	51	72	42	21	36
64	36	55	58	38	13	80	28	64	55	61	44	49	32	37
36	70	31	62	15	15	70	58	76	66	40	13	23	42	72
70	68	22	14	75	19	36	62	47	59	38	71	11	50	34
68	43	27	39	54	60	37	52	36	80	15	53	19	51	72
43	48	41	56	46	16	72	21	70	23	75	33	60	59	73
60	64	10	17	51	18	34	49	68	67	54	37	13	75	79
48	76	18	78	61	82	72	69	43	73	46	12	15	25	80

(d)

Figure

Q52. Write a brief note on image processing techniques?

Answer :

Various digital image processing functions are grouped into four broad type of operations. They are pre-processing, image enhancement,image transformation and image classification.

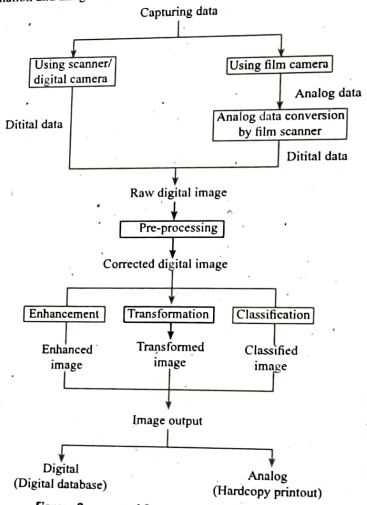


Figure : Sequence of Operations in Digital Processing

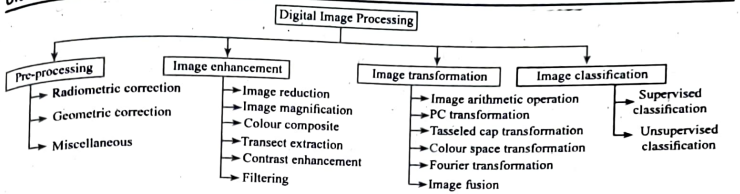


Figure : Major Image Processing Techniques

1. **Pre-processing**

The operations of pre-processing occurs before the main data analysis and extraction of information. They are grouped as radiometric and geometric corrections. The correction of sensor irregularities and unwanted sensor noise are referred as radiometric corrections. Also, conversion of data to accurately represent the emitted or reflected radiation which is measured by the sensor is involved in radiometric corrections. On the other hand, the geometric corrections include correction of geometric distortions due to sensor-earth geometric variations and data conversion to real - world coordinates such as longitudes and latitudes on the surface of the earth.

2. **Image Enhancement**

Image enhancement improves the image appearance for better visual interpretation and analysis. Examples of enhancement functions are contrast stretching and spatial filtering.

3. **Image transformations**

The operations of image transformation is similar to that of image enhancement but the only difference is that, image enhancement operations are applied to single channel (band) of data at once whereas image transformation undergo combined processing of data from multiple spectral bands. Image arithmetic operations, fourier transformation etc., are the examples of image transformations.

4. **Image classifications**

Image classification and analysis operation involves identification and classification of pixels in the data digitally. This operation is performed on multi spectral data sets and allocates each pixel to a particular class depending on statistical characteristics of pixel brightness value.

Q53. What do you mean by Digital Image Processing? Explain basic processes involved.

Answer : April/May-18, (R13), Q5(b)

Digital Image Processing

For answer refer Unit-I, Q50.

Basic Processes Involved

For answer refer Unit-I, Q52.

Q54. Explain about image enhancement.

Answer :

Image enhancement

It is defined as, the conversion of the image quality to a better and more understandable level for image interpretation or feature extraction. Even if the radiometric corrections are made for deficiencies in sensor characteristics and illumination, and due to atmospheric influence in preprocessing, image data cannot be sent to user as the image may still not be optimized for visual interpretation. The image enhancement techniques are applied either to single band images or separately to the individual bands of multi band image set.

The primary objective of image enhancement is to process the image such that the result is more favourable than the original image for specific applications. Image enhancement can be performed by various procedures and can be achieved by two major functions.

1. **Point operations :** It is a radioactive enhancement process, in which the value of each individual pixel is changed independent of other pixels.
2. **Local operations :** It is a spatial enhancement process, in which the values of individual pixel changes with respect to the other pixels or neighbouring pixels.

Various image enhancement techniques are,

1. Image reduction
2. Image magnification
3. Colour composting
4. Transect extraction
5. Contrast enhancement
6. Filtering.

Q55. Discuss about the following image enhancement techniques

1. Image reduction.

2. Image magnification.

3. Colour compositing.

4. Transect extraction.

Answer :

1. **Image Reduction**

In a image captured by the sensor the number of rows and columns generally exceeds the screen resolution of our computer screen. Important to realize that general resolution of screen is 1024 × 768 which is quite lower than the number of pixels generally present in a remotely sensed image. Therefore computer screen cannot display the entire image on the screen unless the visual representation of the image is reduced i.e., zoomed out.

The original digital image is reduced by systematic selection and display of every n^{th} row and column of the image. Consider a image with 5160 rows and 6960 columns, this image can be reduced so that very other row and column (i.e., n = 2) can be selected. Due to this reduction a sampled image having 2580 rows and 3480 columns is created. This reduced dataset contains only 25% of the pixels of an original scene.

39	78	98	45	46	26	55
56	65	65	89	68	58	56
35	19	92	76	75	76	79
42	46	73	59	49	25	85
95	85	81	89	79	18	64
76	79	49	84	67	95	25
51	65	83	65	85	86	87

(i) Original image

40	98	46	50
85	92	75	79
95	61	89	64
51	83	85	87

(ii) Reduced image

Figure : 2x Image Reduction

A simple 2x integer reduction is shown in the above figure. Eventhough a simple 2x integer reduction is often too large to see on most screens. In few cases, image even after under going 2x reduction, complete image cannot be displayed on the screen. Therefore, it is required to sample the data more intensely. The image sampled at 10x reduction which means every tenth row and tenth column of the image are sampled by resulting in 516 rows and 696 columns, which contains only 1% of the original data and is very small enough to view the entire scene within the screen.

2. **Image Magnification**

Image magnification is also called as zoom in. This is most commonly used technique for two purposes.

(i) To match the display - scale of another image.

(ii) To enhance the display-scale of the image for better visual interpretation.

To magnify the image by an integer factor n squared, each pixel in the original image is replaced by n × n block of pixels. An example of the logic of a 2x magnification is shown in the figure. The size of each of the original pixel values are doubled in this type of magnification.

15	20	25
12	17	22
19	24	26

(i) Original image

15	15	20	20	25	25
15	15	20	20	25	25
12	12	17	17	22	22
12	12	17	17	22	22
19	19	24	24	26	26
19	19	24	24	26	26

(ii) Magnified image

Figure : 2x Image Magnification

3. **Colour Compositing**

It is possible to generate a colour image by compositing three selected bands of different - band images by using three primary colours. Images of different colours may be obtained based on the selection of three - band images and the assignment of the three primary colours.

Colour compositing consists of two methods, they are,

(i) **Additive Colour Compositing :** It uses three light sources of three primary colours (RGB). For example, in colour graphic display.

(ii) **Subtractive Colour Compositing :** It uses the three pigments of three primary colours (cyan, magenta and yellow). For example, in colour printing.

4. **Transect Extraction**

Transect is defined as the straight line between any two user-specified points within the image and it is used in many digital image processing applications. Users of remotely sensing images extract brightness values between the points on an image. DNS can be measured by using the pixels lying on the transect. Those pixels can also displayed to compare spatial and spectral differences.

Transect at band 1 Transect at band 2

Transect at band 3 Transect at band 4

Figure : Transects of Multi-Spectral Image

For instance, in the figure variations in the pixel values which occur between the points A and B are measured and the graphs below shows the associated values that obtained between the point A and B for various bands (say 1, 2, 3, 4). In graph the x - axis is distance in pixels and y - axis is raw pixel values and each graph contains a unique distribution. At band 3. The spectral difference occurring along the transect in the band is very large when compared to other bands.

Q56. Explain the following techniques related to image enhancement.

1. Contrast enhancement

2. Filtering.

Answer : **Model Pepar-III, Q3(b)**

1. **Constrast Enhancement**

It is a process that makes the image features more clear by making optimal use of the various colour intensities which are available on the output device or display. Contrast is the measure of the difference in brightness between light and dark areas in a scene.

In remote sensing, the range of the reflectance values which are collected by the sensor may not mach the ability of the colour displaying monitor. Contrast method is used to solve this problem. Materials on the surface of the earth emits and reflects energy in different magnitudes which is being recorded by the sensor in the form of image data, which occupies only a small amount of available range of digital values (Say 8 bits or 250 bits), which is being displaced by a computer screen. By using look - up table (LUT) which is a pre-set function in a computer and is used to convert the input signal to the output signal in real time, when contrast is changed. The original value of brightness does not changes but the computer stores the changed brightness values in LUT and then uses these values while displaying the image.

Consider an image having the brightness values in the range of 40 and 90, when this is stretched to a range of 0 to 255, the differences between the features are enhanced. As different features also reflect similar amounts of energy throughout the electromagnetic spectrum by resulting in a relatively low contrast image. For example, people in developing countries uses natural materials (eg soil, wood) for construction in rural areas, which results in formation of image with lower contrast when compared with urban areas where concrete, asphalt and green vegetation may be more prevalent.

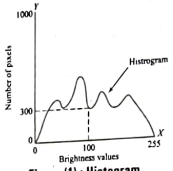
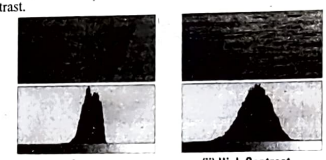


Figure (1) : Histogram

Figure (1) is histogram of an image which is a graphical representation of the brightness values or histogram is a statistical graphic representation of the range of tones from dark to light and associated number of pixels for each tone of an image. Histogram is plotted between the brightness values and number of pixels on x and y axis respectively. Histogram can convey whether or not our image has been properly exposed whether the lightning is harsh or flat.

In figure (2) the narrow histogram refers that less contrast and may appear flat or dull whereas broad histograms shows a scene with significant contrast.



(i) Low Contrast (ii) High Contrast

Figure (2)

The various types of contrast enhancements are,

1. Linear contrast enhancement.
2. Non-Linear contrast enhancement.

2. Filtering

Filtering method is used to enhance the appearance of an image. Mostly spatial filters are used which are designed to highlight or suppress the specific features in an image, based on their spatial frequency. Spatial frequency is related to the image texture, with which grey scale values changes relative to their neighbours within the image.

Smooth area of the image with little variation in tone over several pixels have low spatial frequencies whereas for the areas with rough textures of image the changes in tone are abrupt over a small area which is shown in the above figure.

(i) Zero Spatial Frequency (ii) Low Spatial Frequency (iii) High Spatial Frequency

Figure (3)

By using fourier transform in filtering techniques in the spatial domain or frequency domain by convolution. The normal row/column coordinate system in which images are expressed is called spatial location or spatial domain. If the coordinates of the 2D space in which frequency components are represented as frequency called frequency domain. The single band image is converted from spatial domain representation to the equivalent frequency domain representation and vice versa by using fourier transform. In frequency domain it aims at reconstruction which is so called as reconstruction filters and for spatial domain it aims for enhancement of image which is called as convolution filters.

The various types of filtering methods are,

1. Convolution filtering.
2. Statistical filtering.
3. Frequency domain filter
4. Crisp filters.

Q57. Discuss about a accuracy estimation of image processing.

Answer :

Accuracy Estimation or Accuracy Assessment

Accuracy is the measure of an agreement between a standard which is assumed to be correct and image of unknown quality. If the classification of image corresponds closely with the standard then it is said to be accurate.

Accuracy assessment is a feedback system for checking and evaluating out the correctness of the classified image.

The process of remote sensing data to cartographic product is shown in the figure, which also shows the involvement of accuracy assessment or accuracy estimation.

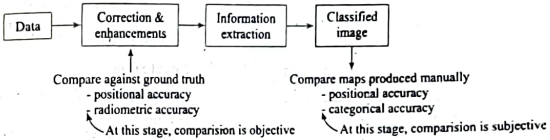


Figure : Process of Remote Sensing Data to Cartographic Data

Accuracy assessments can be completed in many ways. One method is to compare the classified image with the reference image. Random set of points are generated and compares the classification results with the true information classes in the reference image.

In second method, to perform assessment it involves a GPS. Again a set of points are generated over the classified image. By using ground truthing method, which is performed by going into the filed at the location of generated point and then classification results are then compared with actual land-cover at each point's location.

While evaluating classification errors a classification error matrix is formed which is also called as confusion matrix or contingency table and is shown.

		Reference/ground					
		Forest	Water	Urban	Row total	Commission error	User's accuracy
Classified image	Forest	56	28	30	114	51%	49%
	Water	2	30	10	42	29%	71%
	Urban	2	2	40	44	9%	91%
	Column total	60	60	80	200		
	Omission error	7%	50%	50%			
	Producer's accuracy	93%	50%	50%			

Figure : Confusion Matrix

The off - diagonal elements in each column are the samples which are being omitted by the classifier. This misclassification error is called as omission error.

The most commonly used method to summarize the classification results is overall accuracy which is given by,

$$\omega = \frac{\sum_{i=1}^{nc} e_{ii}}{NT} \times 100 \times 100$$

NT – Total number of samples,

Where, $NT = \sum_{i=1}^{nc}\sum_{j=1}^{nc} e_{ij}$

ω – Overall accuracy in %.

nc – Total number of class

e_{ij} – Element in i^{th} row and j^{th} column

e_{ii} – Element in i^{th} row and i^{th} column

From the table, we can obtain overall accuracy as

$$= \frac{(56+30+40)}{200} \times 100$$

$$= 60\%$$

By examining the confusion matrix it is seen that, at least two methods can be used to determine the individual category accuracies, which are

1. The ratio between the number of correctly classified and the column total.
2. The ratio between the number of correctly classified and the row total.

Q58. Explain image classification.

Answer :

Image Classification

Image classification is defined as the categorization of all pixels, which are available in a terrain image into land cover classes. The features of image classification process are land surface elevation and type of soil.

A set of measurements on the selected features for the classification is known as pattern. Therefore, the process of image classification is known as pattern. Therefore, the process of image classification forms a recognition pattern in terms of characteristics of the object or on the earth's surface. This pattern is connected with each pixel position in an image.

(i) Based on pattern recognition, the image classification is classified is classified into two types,

(a) Spectral Pattern Recognition

Spectral pattern recognition is a procedure to categorize automated land cover based on pixel-by-pixel spectral information.

(b) Spatial Pattern Recognition

Spatial pattern recognition is a procedure to categorize image pixels based on the spatial relationship with pixel surrounding them.

(ii) Based on techniques, them image classification is classified into two types,

(a) Supervised Classification

In supervised classification algorithm, the data points are collected from the class of interest for the requirement of a training sample. The supervised classification is carried out based on the nearest data point to each training sample. The stages involved in the procedure of supervised classification are,

(i) Training stage

(ii) Classification stage, and

(iii) Output stage.

(i) Training Stage

In training stage, the analyst helps in identifying the representative training areas and also in developing the numerical descriptions of the spectral signatures of each land cover type of interest.

(ii) Classification Stage

In this stage, each pixel in an image data set is classified into land cover class. If the pixel is inadequately same as any training data set then it is labeled as "unknown".

(iii) Output Stage

The results obtained may be used in a number of different ways. Thematic maps, tables and digital data files are the three typical forms of output products. The output data of image classification becomes input data for geographical information system for spatial analysis of the terrain.

Methods of Supervised Classification

Based on the statistics, the supervised classifiers are classified into following methods,

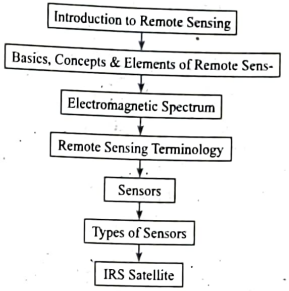
(a) Minimum distance to means method
(b) Average distance method
(c) Parallelopiped method
(d) Maximum likelihood method
(e) Modified maximum likelihood method
(f) Baysian's method
(g) Decision tree method
(h) Discriminant functions method.

Methods of Unsupervised Classification

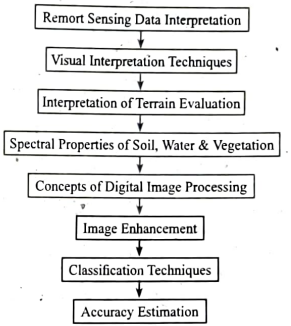
The unsupervised classification algorithm helps in examining a large number of unknown data vectors but do not compare points that are to be categorized with training data. Based on properties, the data vectors are categorized into classes.

MEMORY MAP

I



II



FREQUENTLY ASKED QUESTIONS AND IMPORTANT QUESTIONS

Q1. Explain the phenomenon of energy interactions with earth's surface materials. REPEATED 2 TIMES

Ans: Refer Q29. [May-19, (R16), Q5(b) | Nov./Dec.-16, (R13), Q5(b)]

Q2. What are the types of resolution involved in Remote Sensing? Explain. REPEATED 2 TIMES

Ans: Refer Q38. [April/May-18, (R13), Q5(a) | Nov./Dec.-17, (R13), Q5(a)]

Q3. List the advantages of remote sensing.

Ans: Refer Q3. Important Question

Q4. What are the range of wavelengths in the various EMR spectrum?

Ans: Refer Q5. Important Question

Q5. Write a short note on atmosphere properties.

Ans: Refer Q6. Important Question

Q6. Write a short note on energy interaction with earth surface features. Sketch the approximate shape of the reflactance curve for clear water and turbid water.

Ans: Refer Q8. Important Question

Q7. Write about meteorological satellites.

Ans: Refer Q10. Important Question

Q8. What is visual interpretation?

Ans: Refer Q12. Important Question

Q9. Write in brief about an image.

Ans: Refer Q15. Important Question

Q10. What is remote sensing? Give its classification?

Ans: Refer Q16. Important Question

Q11. Explain the components of remote sensing with a neat sketch.

Ans: Refer Q20. Important Question

Q12. Discuss remote sensing terminology and units.

Ans: Refer Q22. Important Question

Q13. Discuss in detail about the electromagnetic spectrum.

Ans: Refer Q25. Important Question

Q14. Explain the major divisions of electromagnetic spectrum.

Ans: Refer Q26. Important Question

Q15. Briefly discuss the following :

(a) Planck's law

(b) Stephen Boltzmann's law

(c) Wein's displacement law.

Ans: Refer Q28. Important Question

Q16. What are the types of scattering? Explain.

Ans: Refer Q31. Important Question

Q17. What are the different effects of atmosphere on spectral response?

Ans: Refer Q33. Important Question

Q18. What are the various orbits in which satellite can exist? Discuss.

Ans: Refer Q36. Important Question

Q19. List the Indian Satellite and Sensor resolution characteristics.

Ans: Refer Q39. Important Question

Q20. What do you mean by IRS? Give Examples.

Ans: Refer Q41. Important Question

Q21. Write in brief about the sensor characteristics of:

(a) IRS satellite.

(b) LANDSAT.

Ans: Refer Q42. Important Question

Q22. What is visual interpretation? What are the basic elements to be considered during visual interpretation of satellite images?

Ans: Refer Q43. Important Question

Q23. Explain the different applications of aerial photo interpretation.

Ans: Refer Q45. Important Question

Q24, Discuss spectral properties of soil, water and vegetation?

Ans: Refer Q49. Important Question

Q25. What do you mean by Digital Image Processing? Explain basic processes involved.

Ans: Refer Q53. Important Question

Q26. Discuss about the following image enhancement techniques

1. Image reduction.
2. Image magnification.
3. Colour compositing.
4. Transect extraction.

Ans: Refer Q55. Important Question

Q27. Explain the following techniques related to image enhancement.

1. Contrast enhancement
2. Filtering.

Ans: Refer Q56. Important Question

Q28. Explain image classification.

Ans: Refer Q58. Important Question