INSTITUTE OF REMOTE SENSING
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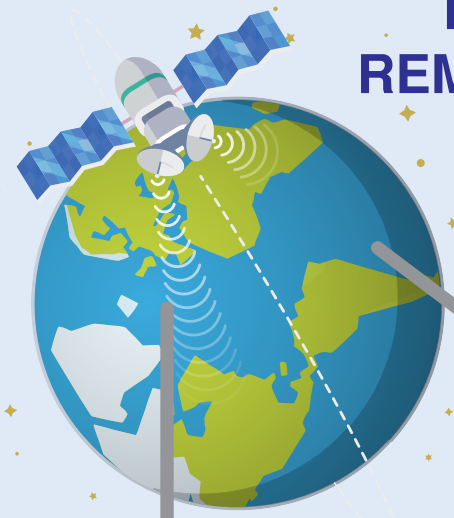
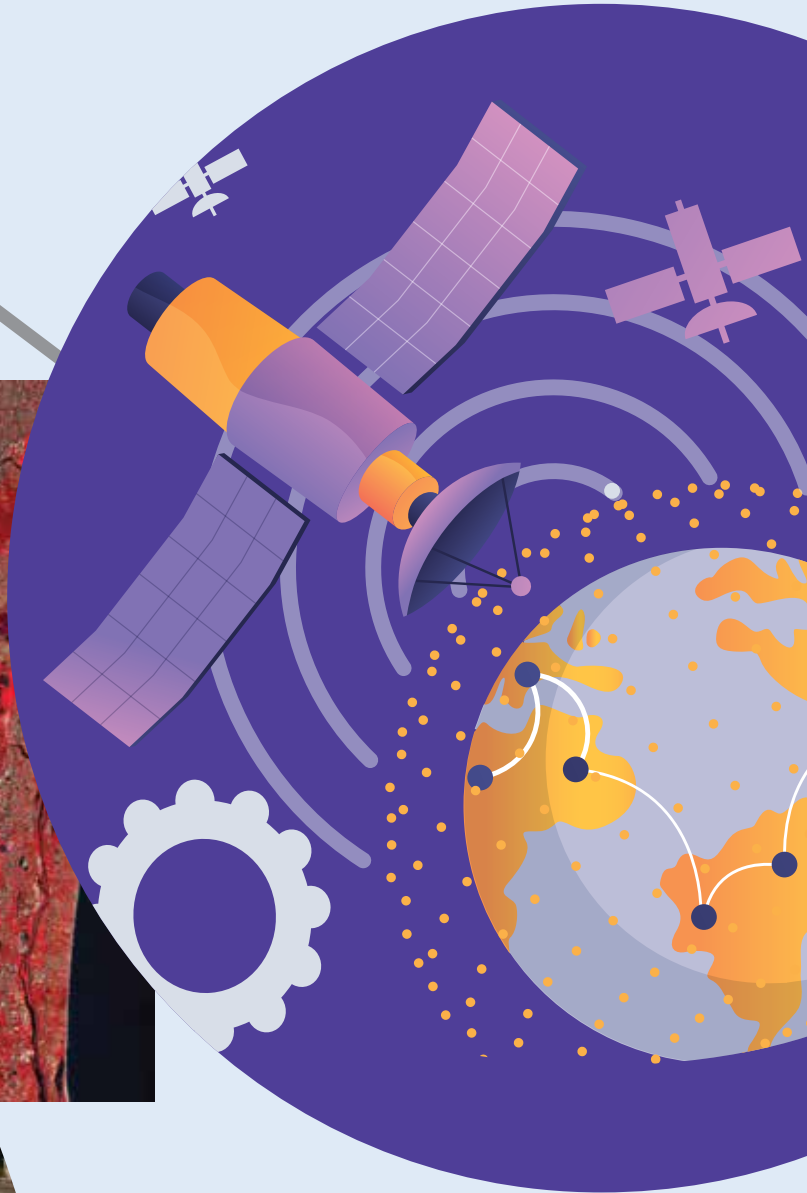
LAB MANUAL
REMOTE SENSING LABORATORY





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EXPT NO. 1	PREPARATION OF BASE MAP FROM SURVEY OF INDIA TOPO SHEETS	DATE OF EXPT:

AIM:

To prepare a base map from survey of India topo sheet using tracing sheet.

MATERIALS REQUIRED:

- Survey Of India topo sheet
- Tracing sheet
- Light table

TOPOSHEET:

- Topo sheet is type of map characterized by large scale details and quantitative representation of relief usually using contour line but historically using a variety of methods.
- Traditional require a topographic map to show both natural and man-made features.
- A topographic survey is typically published as a map series, made up of two or more sheets that combine to from the whole map.
- A contour line is a line connecting places of equal elevation.
- It usually shows geographic and a coordinate grid so that you can determine relative and absolute position of mapped features.
- The survey of India is responsible for all topographic control, survey and mapping of India

TOPO MAP INDEX OF SOI:

- The map produced by survey of India are of different scales. In order to identify a map of an area, numbering system has been adopted by survey of India.
- The international series (within 4 N to 40 N latitude and 44 E TO 124 E longitude) at the scale of 1;10,00,000 is used as base map.

- The base map is further divided into sections of 4 latitude × 4 longitude and designated from 1 to 136 consisting of segments that cover only land area.
- The Indian topographic maps are 1 latitude × 1 longitude at 1:2,50,000 ratio and segments from A to P column wise, which is further divided into 15' × 15' as 16 segments at 1:50,000 ratio and named from 1 to16 which is further divided into cardinal direction at 7 ½'' × 7 ½'' at 1:25,000 ratio.
- North arrow and scale of map, orientation are indicated. Legend is created for all features in the map.

BASE MAP:

- A base map provides both the function foundation and the initial building blocks for creating your map.
  It provides us with a geological and visual context for data. Whether yours map is a fixed image or interactive feature.
- Simply the base map will normally provide one or most of the following features.
  Streets
  Land marks
  Boundaries
  Waterways.
- Base map is a map having only essential outlines and used for the plotting or presentation of specialized data of various kinds.

PROCEDURES:

- Place the survey of India topo sheet on the tracing table. Switch on the lights of tracing table.
- Check whether all the features in the survey of India topo sheet are clearly visible.
- Align and adjust the tracing sheet over the selected area to be tracing.
- Carefully trace without moving the tracing sheet and identify them and trace it.

- Now keep the traced tracing sheet over the satellite image and update the feature in it.
- Create a legend clearly indicated the base map features and updated features.

RESULT:

The base map is created using tracing sheet from SOI topo sheet and features are updated from corresponding satellite image.

EXPT NO. 2A	INTRODUCTION TO VARIOUS SATELLITE DATA PRODUCTS AND IMAGE INTERPRETATION KEYS	DATE OF EXPT:

AIM:

- To visually interpret satellite image and perform level 1 classification.

MATERIALS USED:

- Satellite image (map ID : 58F05)
- 15 µm tracing sheet
- Tracing table

VISUAL IMAGE INTERPRETATION:

- Visual perception is the ability to interpret information and surrounding from the effects of visible light reaching the eye. Interpretation is the process of extraction of qualitative and quantitative information of object from aerial photographs or satellite image. Visual interpretation involves visual analysis of aerial photographs or satellite images.
- Visual image interpretation is the process of identifying features seen on the image by an analyst from these image to others.

IMAGE INTERPRETATION TASKS:

- The image interpretation procedure is complex task and requires several task to be conducted in a methodical manner which include:
- Enumeration is the task of listing or counting discrete item visible on an image.
- Delineation involves separating distinct aerial units that are characterized by specific tones and image textures.
  Visual image interpretation employ combination of the following eight elements.
- **Shape**

- Shape refers to the general form, configuration or outline of individual objects. The shape of some objects is so distinctive that their image may be identified solely from this criterion example: pentagon building near Washington Dc.
- **Size**
- Size of objects on image must be considered in the context of the same scale also be considered.
- **Pattern**
- Pattern refers to the spatial arrangements of object (natural and constructed) that aids the image interpreter in recognizing them.
- **Tone**
- Tone (or hue) refers to the relative brightness or color of objects on an image. Without tone difference, the shape patters and textures of objects could not be discerned.
- **Texture**
- Texture is the frequency of tonal change on an image.
- **Shadows**
- The shape or outline of shadows affords an impression of the profile view of objects.
- **Site**
- Site refers to topographic or geographic location and is a particular important aid in the identification of vegetation types.
- **Association**
- Association refers to occurrence of certain features in relation to others.

LEVELS OF SATELLITE DATA PRODUCTS:

- The various levels of data products based on the level of data processing are

LEVEL 0

The input raw data received at a ground station is converted into a certain storage format is level 0 image. Level 0 imagery is a raw instrument data. Since there are some fundamental correction should be applied to the data, before they are usable, most agencies will not distribute L0 imagery.

LEVEL 1

Level 1 data are radio metrically corrected. Radiometric distortions arising due to non-uniform response of the detectors, specific element failure, data losses during communication and image to image variations.

LEVEL 2

Level 2 data are geometrically corrected. Geometric distortions due to earth rotation, sensor focal plane detector geometry, alignment of optical axis.

LEVEL 3

Level 3 data are free of radiometric and geometric distortions. It also includes map projection and image orientation to north.

COMMON EARTH SURFACE FEATURES

The most commonly observed earth surface feature are land, water and vegetation. These three classes are basic features. Earth feature in the earth given unique spectral reflectance. These spectral response patterns help in discriminating different objects on the earth surface.

VEGETATION:

Healthy vegetation is a good absorbers of electromagnetic energy in the visible region. Chlorophyll strongly absorbs light at wavelength around 0.45 (blue) and 0.67 μ (red) and reflects strongly in green light, therefore our eyes perceive healthy vegetation as green. Healthy plants give a high reflectance in near infrared between 0.7 and 1.3μm due to internal structure of leave.

WATER:

In its liquid state, water has relatively low reflectance, with clear water having the greatest reflectance in the blue portion of the visible part of the spectrum. Water has no reflectance in near infrared wavelength range and beyond.

LAND:

Land refers to the surface of earth that is not covered by water. Land can be observed in two perspectives land use and land coves. Land use refers to land used

by people for various purpose Ex :Agricultural land. Land cover defines the natural material on land surface. Ex: Forest.

LEVEL 1 CLASSIFICATION:

Level classification is dependent on spatial resolution of the image. Maximum resolution need for level 1 classification is so mater. The various land cover classes at level 1 classification (according to USGS Anderson land classification scheme) are

- Urban or built-up land
- Agricultural
- Forestland
- Water
- Wetland
- Barren land
- Tundra
- Perennial snow or ice

IMAGE COMPOSITES:

Each band of a multispectral image can be displayed as a combination of three bands time as a color composite image. Computer screens can display an image composed of three different bands.

NATURAL OR TRUE COLOR COMPOSITE (TCC) :

A natural composite is an image displaying a combination of visible red, green and blue bands to the corresponding red, green and blue channels on compute display. The resulting composite resembles what would be observed naturally by human eye: vegetation appears green, water appears blue, bare ground and other surface appears light gray and brown.

FALSE COLOR COMPOSITE (FCC):

FCC allows us to visual size wavelengths that the human eye cannot see (ie, near infrared and beyond). Using bands such as NIR highlights the spectral

differences and often increase the interpretability of the spectral differences there are many different FCC's that can be used to highlight different features.

STANDARD FCC:

In standard FCC, green band is assigned blue, red band as green and NIR band as red. Vegetation appears in shades of red, urban areas are white or cyan, soil vary from dark to light brown. This combination is useful for vegetation studies, monitoring drainage and soil patterns and various stages of crop growth.

DETAILS OF TRACED SATELLITE IMAGERY:

- Map ID : 58F05
- Sensor : IRS 1C
- Data product type : standard
- Data processing level : level 3
- Coordinates :

  Upper left 77 15' E 11 0' N
  Upper right 77 30' E 11 0' N
  Upper left 77 15' E 10 45' N
  Upper right 77 30' E 10 45' N

FCC: Standard (2 3 4)

Green band (520-590nm) - Blue

Red band (620-680nm) – Green

NIR band (770 -860) - Red

Observed data: 4 –Feb -1997

Satellite path and row: PI00 , R066

Person observed : ISRO / NRSA

Dumped data : 7-Feb- 1997

PROCEDURE:

- The quality of topo sheet is checked for wear and tear.
- The satellite name, topo sheet number, time of capture and time of printing and other noted down.
- The tracing sheet is placed upon the satellite image
- The required feature are traced and legend is drawn.
- Land appeared cyan, water bodies appeared black and vegetation appeared as colour.
- The tracing sheet is attached.

RESULT:

Thus the satellite imagery was visually interpreted and features in the image classified based on level 1 classification.

EXPT NO. 2B	INTRODUCTION TO VARIOUS SATELLITE DATA PRODUCTS AND IMAGE INTERPRETATION KEYS	DATE OF EXPT:

AIM:

To visually interpret satellite image to create land use land cover map with level 2 classification.

MATERIALS USED:

- Satellite image (map ID :55E05)
- 15µm tracing sheet
- Tracing table

VISUAL IMAGE INTERPRETATION:

Visual image interpretation is the process of identifying features seen the image by an analyst / interpreter and communication of information obtained from these image to others.

ELEMENTS OF VISUAL IMAGE INTERPRETATION:

Visual image interpretation employ combination of the following eight elements.

1) Shape:

Shape refers to the general from, configuration or outline of individual objects. The shape of some objects is so distinctive that their image may be identified solely from this criterion Ex: pentagon building near Washington, DC.

2) Size:

Size of object on image must be considered in the context of the image scale. Relative sizes among objects on image of the same scale must also be considered.

3) Pattern:

Pattern refers to the spatial arrangement of objects (natural and constructed) that aids the image interpreter in recognizing them. For example, the ordered spatial arrangement of trees in orchard is in district contrast to that of tree stands.

4) Tone:

Tone (or hue) refers to the relative brightness or color of objects on an image. Without tonal differences, the shape, patterns and textures of objects could not discerned.

5) Texture:

Texture is the frequency of tonal change on an image. It determines the overall visual ‘’smoothness’’ or ‘’coarseness’’ of image features.

6) Shadows:

The shape or outline of shadows affords an impression of the profile view of object.

7) Site:

Site refers to topographic or geographic location and is a particular important aid in the identification of vegetation types.

8) Association:

Association refers to occurrence of certain features in relation to others.

LAND USE LAND COVER (LULC) CLASSIFICATION:

Land use refers to the purpose of land serves, for example, recreation, wildlife habitat or agriculture; it does not describe the surface cover on the ground. For example, a recreational land use could occur in a forest, shrub land, and grass land or on manicured lawns.

Land cover refer to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other; it does not describe the use of land. The use of land may be different for land with the same cover type. For instance, a

land cover type of forest may be used for timber production , wildlife management or recreation.

LEVEL 2 CLASSIFICATION:

Level 2 classification of land use land cover (LULC) requires combination of different interpretation elements. The three basic classes in level (land, water, and vegetation) can be further subdivided in level 2 classification.

Level 1	Level 2
Vegetation	Forest, agriculture, shrubs, grassland
Land	Barren, built up
Water	Water bodies, streams

Details of traced satellite imagery:

- Map ID : 58F05
- Sensor :IRS IC
- Data product type : standard
- Data processing level : level 3

Coordinates :

- Upper left 77º 15'E 11º 0'N
- Upper right 77º 30'E 11º 0'N
- Upper left 77º 15'E 10 º 45'N
- Upper right 77º 30'E 10 º 45'N

Spectral band: 2 3 4

Observed data: 4- Feb -1997

Satellite path & row: P100/R066

Person observed: ISRO/NRSA

Dumped date: 7-feb-1997

FCC: Standard (2 3 4)

- Green band (520-590nm) –blue
- Red band (620-680nm) -green
- NIR band (770-860nm) -red

PROCEDURE:

- The quality of the satellite image is checked for wear and tear.
- The satellite name, image numbers, time of capture, spectral bands and other details are noted down.
- The tracing sheet is placed over satellite imagery and the bounding coordinates are drawn for the required grid.
- Use combination of interpretation elements to identify level 2 classes.
- Trace out different LULC classes of level 2 which are present in the image.
- Create legend indicating different LULC classes.
- The tracing sheet is attached.

RESULT:

The given satellite image was classified into different LULC classes based on level 2 classification.

OBSERVATION:

Features		Tone	Texture	Shape	Size	Pattern	Shadow	Association
Level1	Level 2							

EXPT NO. 2C	INTRODUCTION TO VARIOUS SATELLITE DATA PRODUCTS AND IMAGE INTERPRETATION KEYS	DATE OF EXPT:

AIM:

- To visually interpret satellite image and to create land use land cover map with level 3 classification.

MATERIALS USED:

- Satellite image (map ID :58F05)
- Satellite image (map ID :57P05)
- 15µm tracing sheet
- Tracing table

VISUAL IMAGE INTERPRETATION:

Visual image interpretation in the process of identifying features seen on the image by an analyst /interpreter and communication of information about images.

ELEMENTS OF VISUAL IMAGE INTERPRETATION:

Visual image interpretation employ combination of the following eight elements.

1) Shape:

Shape refers to the general form, configuration or outline of individual objects. The shape of some objects is so distinctive that their image may be identified from this criterion.

2) Size:

Size of the objects on image must be considered in the context of the image scale. Relative size among objects on image of same scale must also be considered.

3) Pattern:

Pattern refers to the spatial arrangement of objects (natural and constructed) that aids image interpret recognizing tem.

4) Tone:

Tone (or Hue) refers to the relative brightness or color of object on an image. Without tonal difference, the shaped, pattern and textures of objects could not discerned.

5) Texture:

Texture is the frequency of tonal change on an image it determines the overall visual ‘’smoothness’’ or ‘’coarseness’’ of image features.

6) Shadows:

The shape or outline of shadows affords an impression of the profile view of objects.

7) Site:

Site refers to topographic or geographic location and is a particular important aid in the identification of vegetation types.

8) Association:

Association refers to occurrence of certain features in relation to others.

LAND USE LAND COVER (LULC):

Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare, soil or other.

Land use refers to the purpose of land serves, for example, recreation, wildlife habitat or agriculture.

LEVEL 3 CLASSIFICATION:

The level 3 classes are further divided in level 3 classification.

Level 1	Level2	Level3
Vegetation	Agriculture	Cultivated Non- cultivated
Land	Barren	Non-cultivated
	Built up	Residential or ads
Water	Water bodies	streams

Details of traced satellite image:

Image 1

- Map ID : 58F05
- Sensor : IRS IC
- Data product : standard
- Data level : level3
- Coordinates:

Top left	77 15’E , 11 0’N
Top right	77 30’E , 11 0’N
Bottom left	77 15’E , 10 45’N
Bottom right	77 30’E , 10 45’N

- Spectral band :2 3 4
- Observed data :4-feb-1997
- Satellite path & row : P00/R066
- Person observed : ISRO /NASA
- Dumped data : 7- feb-1997
- FCC : Standard (2 3 4)

Green band (520-590nm) -blue

Red band (620-680nm) -green

NIR band (770-860nm) -red

Image 2:

- Map ID: 57P05
- Area : North Arcot
- Sensor : IRS IC
- Data product : standard
- Data level : level 3
- Spectral band : 2 3 4
- Observed data : 23- Mar-1997
- Dumped data : 24-Mar-1997
- Person observed : ISRO/NASA
- Satellite path & row :P100/R066

PROCEDURE:

- The quality of the satellite image is checked for wear and tear.
- The satellite name, image numbers, time of capture, spectral band and others details are noted down.
- The tracing sheet is placed over satellite imagery and the bounding coordinate are drawn for the required grid.
- Use combination of interpretation elements to identify c=different classes in level 3
- Trace out different LULC classes of level 3 which are present in the image.
- Create legend indicating different LULC, classes.
- The tracing sheet is attached.

RESULT:

The given satellite image was classified into different LULC classes based on level 3 classification.

EXPT NO. 3	PREPARATION OF LAND USE/LAND COVER MAP USING SATELLITE DATA	DATE OF EXPT:

AIM:

To prepare land use land cover map using satellite data

MATERIALS REQUIRED:

1. Satellite imagery (e.g., Landsat, Sentinel-2, or similar).
2. Geographic Information System (GIS) software (e.g., ArcGIS, QGIS, or ERDAS Imagine).

PROCEDURE:

1. **Image Acquisition:**
   - Obtain satellite imagery from sources such as USGS Earth Explorer or Copernicus Open Access Hub.
   - Ensure the imagery has sufficient spatial and spectral resolution for LULC classification.
2. **Preprocessing:**
   - Load the satellite image into GIS software.
   - Perform radiometric and geometric corrections to remove distortions.
   - Conduct atmospheric corrections if required.
   - Clip the image to the study area boundary using a shapefile.
3. **Data Layer Creation:**
   - Identify bands suitable for LULC classification (e.g., NIR for vegetation, SWIR for water).
   - Generate composite images using selected bands.
4. **Classification:**
   - Use unsupervised classification (e.g., ISODATA or k-means clustering) for initial analysis.
   - Perform supervised classification by training the model with ground truth data. Classes may include:
     - Built-up area
     - Agricultural land
     - Forests
     - Water bodies

        - Barren land
    - Choose a suitable classification algorithm (e.g., Maximum Likelihood, Random Forest).
5. **Post-classification Processing:**
    - Smoothen the classified image using a majority filter to reduce noise.
    - Reclassify if errors are identified.
    - Integrate ancillary data for validation.
6. **Accuracy Assessment:**
    - Prepare an error matrix by comparing classified data with ground truth points.
    - Calculate accuracy metrics like Overall Accuracy, Kappa Coefficient, and User/Producer Accuracy.
7. **Map Preparation:**
    - Assign appropriate colors to different classes.
    - Add map elements such as title, legend, north arrow, and scale bar.
    - Export the final map in a suitable format (e.g., TIFF, JPEG, or PDF).
8. **Documentation:**
    - Prepare a report detailing the methods used, observations, and results.

RESULT:

The Land Use/Land Cover map of the given study area has been successfully prepared. The map highlights spatial distribution and percentage coverage of various land cover classes, which can be used for resource planning and management.

CALCULATION:

Class Name	Area (sq. km)	Percentage Coverage (%)
Built-up Area		
Agricultural Land		
Forests		
Water Bodies		
Barren Land		

EXPT NO. 4A	PREPARATION AND ANALYSIS OF SPECTRAL SIGNATURES USING HANDHELD SPECTRO RADIOMETER	DATE OF EXPT:

AIM:

To prepare and analyze the spectral signatures of vegetation using a Handheld spectro-radiometer and understand their significance in remote sensing applications.

MATERIALS REQUIRED:

1. Handheld spectro-radiometer
2. ENVI

PROCEDURE:

1. **Instrument Setup:**
   - Calibrate the spectro-radiometer using the white reference panel as per the manufacturer's instructions.
   - Ensure the device is set to the appropriate spectral range (e.g., visible to NIR).
2. **Site Selection:**
   - Identify representative locations for vegetation, soil, and water.
   - Mark the locations using a GPS device.
3. **Data Collection:**
   - For each sample type (vegetation, soil, water):
     1. Position the spectro-radiometer sensor above the target at the recommended height and angle.
     2. Record the spectral data under stable lighting conditions (preferably clear skies and midday).
     3. Note environmental conditions (e.g., cloud cover, temperature) in the field notebook.
4. **Data Storage:**
   - Save the spectral readings with proper naming conventions (e.g., vegetation_site1, soil_site2).
   - Export data for further analysis.
5. **Spectral Signature Analysis:**

- Load the collected data into spectral analysis software.
- Plot the spectral curves for vegetation, soil, and water.
- Compare observed curves with standard spectral profiles.

6. **Interpretation:**
   - Identify key absorption and reflectance features in the spectra.
   - Analyze differences between vegetation, soil, and water signatures.
7. **Visualization:**
   - Create graphs displaying spectral reflectance curves for all samples.
   - Highlight significant wavelengths corresponding to target characteristics.

RESULT:

The spectral signatures of vegetation was successfully prepared and analyzed. The characteristic reflectance patterns for each sample type were identified, demonstrating their unique spectral properties useful for remote sensing applications.

CALCULATION:

Sample Type	**Wavelength (nm)**	**Reflectance (%)**
Vegetation		

EXPT NO. 4B	PREPARATION AND ANALYSIS OF SPECTRAL SIGNATURES USING HANDHELD SPECTRO RADIOMETER	DATE OF EXPT:

AIM:

To prepare and analyze the spectral signatures of soil using a handheld spectro-radiometer and understand their significance in remote sensing applications.

MATERIALS REQUIRED:

Handheld spectro-radiometer

ENVI

PROCEDURE:

Instrument Setup:

- Calibrate the spectro-radiometer using the white reference panel as per the manufacturer's instructions.
- Ensure the device is set to the appropriate spectral range (e.g., visible to NIR).

Site Selection:

- Identify representative locations for vegetation, soil, and water.
- Mark the locations using a GPS device.

Data Collection:

- For each sample type (vegetation, soil, water):
    1. Position the spectro-radiometer sensor above the target at the recommended height and angle.
    2. Record the spectral data under stable lighting conditions (preferably clear skies and midday).
    3. Note environmental conditions (e.g., cloud cover, temperature) in the field notebook.

Data Storage:

- Save the spectral readings with proper naming conventions (e.g., vegetation_site1, soil_site2).
- Export data for further analysis.

Spectral Signature Analysis:

- Load the collected data into spectral analysis software.
- Plot the spectral curves for vegetation, soil, and water.
- Compare observed curves with standard spectral profiles.

Interpretation:

- Identify key absorption and reflectance features in the spectra.
- Analyze differences between vegetation, soil, and water signatures.

Visualization:

- Create graphs displaying spectral reflectance curves for all samples.
- Highlight significant wavelengths corresponding to target characteristics.

RESULT:

The spectral signatures of soil was successfully prepared and analyzed. The characteristic reflectance patterns for each sample type were identified, demonstrating their unique spectral properties useful for remote sensing applications.

CALCULATION:

Sample Type	**Wavelength (nm)**	**Reflectance (%)**
soil		

EXPT NO. 4C	PREPARATION AND ANALYSIS OF SPECTRAL SIGNATURES USING HANDHELD SPECTRO RADIOMETER	DATE OF EXPT:

AIM:

To prepare and analyze the spectral signatures of water using a handheld spectro-radiometer and understand their significance in remote sensing applications.

MATERIALS REQUIRED:

Handheld spectro-radiometer

ENVI

PROCEDURE:

Instrument Setup:

- Calibrate the spectro-radiometer using the white reference panel as per the manufacturer's instructions.
- Ensure the device is set to the appropriate spectral range (e.g., visible to NIR).

Site Selection:

- Identify representative locations for vegetation, soil, and water.
- Mark the locations using a GPS device.

Data Collection:

- For each sample type (vegetation, soil, water):
    1. Position the spectro radiometer sensor above the target at the recommended height and angle.
    2. Record the spectral data under stable lighting conditions (preferably clear skies and midday).
    3. Note environmental conditions (e.g., cloud cover, temperature) in the field notebook.

Data Storage:

- Save the spectral readings with proper naming conventions (e.g., vegetation_site1, soil_site2).
- Export data for further analysis.

Spectral Signature Analysis:

- Load the collected data into spectral analysis software.
- Plot the spectral curves for vegetation, soil, and water.
- Compare observed curves with standard spectral profiles.

Interpretation:

- Identify key absorption and reflectance features in the spectra.
- Analyze differences between vegetation, soil, and water signatures.

Visualization:

- Create graphs displaying spectral reflectance curves for all samples.
- Highlight significant wavelengths corresponding to target characteristics.

RESULT:

The spectral signatures of water was successfully prepared and analyzed. The characteristic reflectance patterns for each sample type were identified, demonstrating their unique spectral properties useful for remote sensing applications.

CALCULATION:

Sample Type	**Wavelength (nm)**	**Reflectance (%)**
Water		