Department of Civil Engineering
Name of the subject: CE2024 Remote Sensing Tetchiness and GIS
Two marks &16marks

UNIT I

EMRAND ITSINTERACTIONWITH ATMOPHEREAND EARTH MATERIAL

1.What is remote sensing?

Remote sensing is the science and art of obtaining information about on object, area, or phenomena through the analysis of data acquired by a device that is not in contact with the object, area, or phenomena under investigation.

2.What are all the applications of remote sensing?

In many respects, remote sensing can be thought of as a reading process. Using various sensors, we remotely collect data that may be analyzed to obtain information about the objects, areas, or phenomena being investigated. The remotely collected data can be of many forms, including variations in force distributions, acoustic wave distributions, or electromagnetic energy distributions.

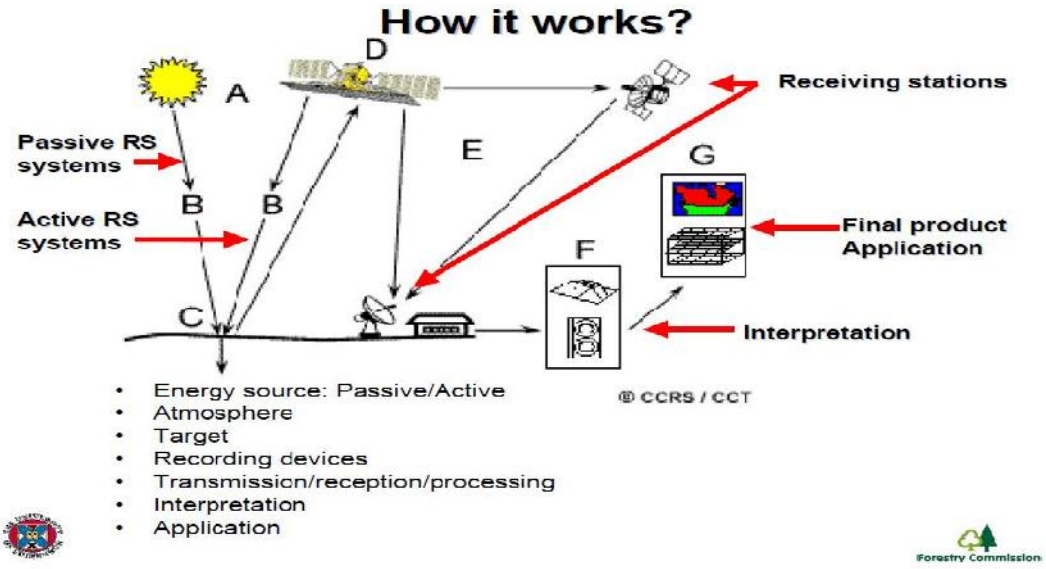
3.Write the physics of remote sensing ?

Visible light is only one of many forms of electromagnetic energy. Radio waves, heat, ultraviolet rays, and X-rays are other familiar forms. All this energy is inherently similar and radiates in accordance with basic wave theory. This theory describes electromagnetic energy as traveling in harmonic, sinusoidal fashion at the "velocity of light" c. The distance from one wave peak to the next is the wave length ψ, and the number of peaks passing a fixed point in space per unit time is the wave frequency V.

From basic physics, wave obey the general equation

$$C = v\ y$$

4.What are the Components of Remote Sensing ?



5.What is Electromagnetic radiation?

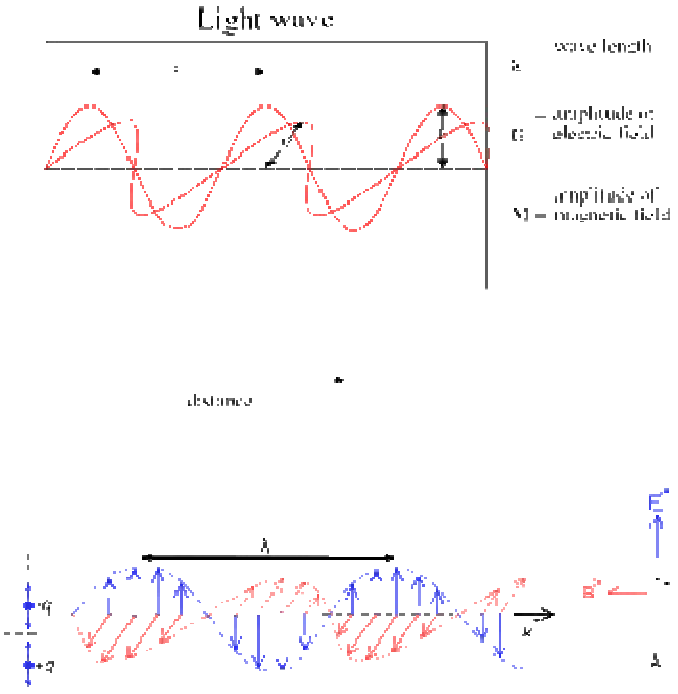
Electromagnetic (EM) radiation is a self-propagating wave in space or through matter. EM radiation has an electric and magnetic field component which oscillate in phase perpendicular to each other and to the direction of energy propagation.

6.Write the type of Electromagnetic radiation?

Electromagnetic radiation is classified into types according to the frequency of the wave, these types include (in order of increasing frequency): radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays.

7.Draw the quantum theory interaction?

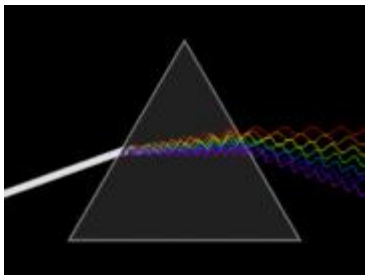
A quantum theory of the interaction between electromagnetic radiation and matter such as electrons is described by the theory of quantum electrodynamics.



8.Write about refraction?

In refraction, a wave crossing from one medium to another of different density alters its speed and direction upon entering the new medium. The ratio of the refractive indices of the media determines the degree of refraction, and is summarized by Snell's law. Light disperses into a visible spectrum as light is shone through a prism because of refraction.

9.Draw the Wave model?



10.Write Planck's equation?

The frequency of the wave is proportional to the magnitude of the particle's energy. Moreover, because photons are emitted and absorbed by charged particles, they act as transporters of energy. The energy per photon can be calculated by Planck's equation:

where E is the energy, h is Planck's constant, and f is frequency.

11.What is Black body ?

By definition a *black body* is a material that absorbs all the radiant energy that strikes it. A black body also radiates the maximum amount of energy, which is dependent on the kinetic temperature.

12.Write Stefan Boltzman law?
According to the Stefan-Boltzman law the radiant flux of a
black body, Fb, at a kinetic temperature, Tkin, is Fb = s* Tkin
4 where s is the Stefan- Boltzman constant, 5.67*10-12 W*cm-2*°K-4.

13.What is emissivity?
Emissivity is a measure of the ability of a material to both radiate and absorb energy. Materials with a high emissivity absorb and radiate large proportions of incident and kinetic energy, respectively (and vice-versa).

14.Write Wein's Displacement law?

For an object at a constant temperature the radiant power peak refers to the wavelength at which the maximum amount of energy is radiated, which is expressed as lmax. The sun, with a surface temperature of almost 6000°K, has its peak at 0.48mm (wavelength of yellow). The average surface temperature of the earth is 290°K
(17°C), which is also called the *ambient temperature*; the peak concentration of energy emitted from the earth is at 9.7mm.This shift to longer wavelengths with decreasing temperature is described by Wien's displacement law, which states:

lmax = 2,897mm°K /Trad°K

.

15.Write Planck's Law?

The primary law governing blackbody radiation is the *Planck Radiation Law*, which governs the intensity of radiation emitted by unit surface area into a fixed direction (solid angle) from the blackbody as a function of wavelength for a fixed temperature. The Planck Law can be expressed through the following equation.

16.What is Scattering?

Scattering occurs when particles or large gas molecules present in the atmosphere interact with and cause the electromagnetic radiation to be redirected from its original path. How much scattering takes place depends on several factors including the wavelength of the radiation, the abundance of particles or gases, and the distance the radiation travels through the atmosphere. There are three (3) types of scattering which take place.

17.What are the types of scattering?

(i) Rayleigh scattering occurs when particles are very small compared to the wavelength of the radiation.

(ii) Mie scattering

It occurs when the particles are just about the same size as the wavelength of the radiation.

(iii) Non Selective Scattering

The final scattering mechanism of importance is called **nonselective scattering**. This occurs when the particles are much larger than the wavelength of the radiation.

18.What is Atmospheric Windows?

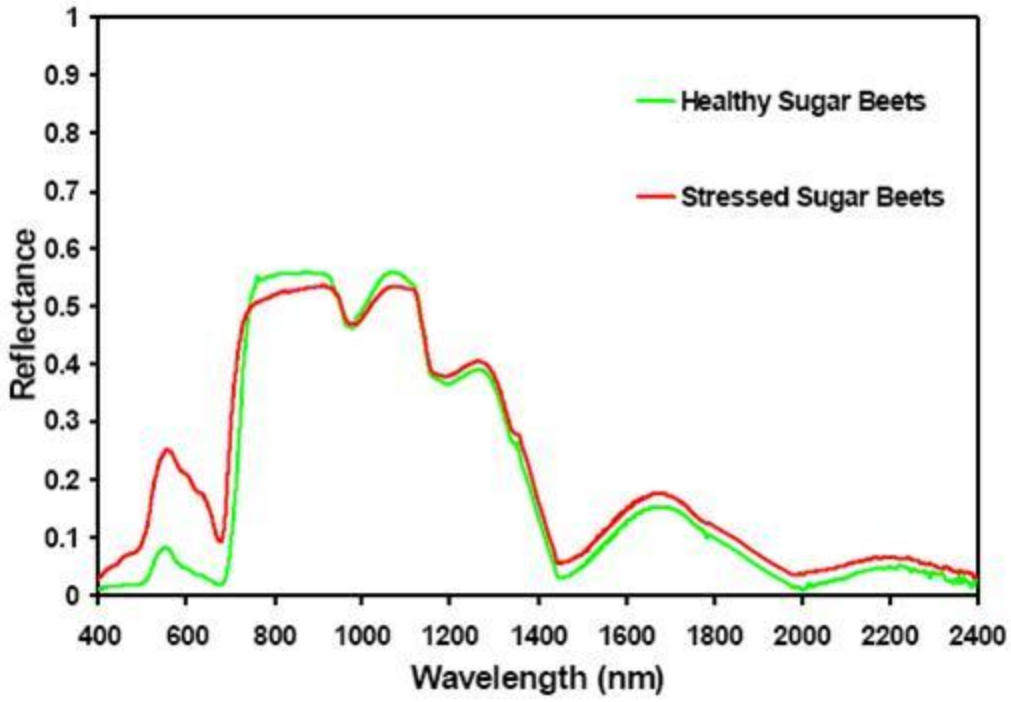
The areas of the spectrum which are not severely influenced by atmospheric absorption and thus, are useful to remote sensors, are called **atmospheric windows**.

PART B

1. Discuss on spectral signature and its rule in identifying objects with suitable diagrams.

Spectral signature in remote sensing

Features on the Earth reflect, absorb, transmit, and emit electromagnetic energy from the sun. Special digital sensors have been developed to measure all types of electromagnetic energy as it interacts with objects in all of the ways listed above. The ability of sensors to measure these interactions allows us to use remote sensing to measure features and changes on the Earth and in our atmosphere. A measurement of energy commonly used in remote sensing of the Earth is reflected energy (e.g., visible light, near-infrared, etc.) coming from land and water surfaces. The amount of energy reflected from these surfaces is usually expressed as a percentage of the amount of energy striking the objects. Reflectance is 100% if all of the light striking and object bounces off and is detected by the sensor. If none of the light returns from the surface, reflectance is said to be 0%. In most cases, the reflectance value of each object for each area of the electromagnetic spectrum is somewhere between these two extremes. Across any range of wavelengths, the percent reflectance values for landscape features such as water, sand, roads, forests, etc. can be plotted and compared. Such plots are called "spectral response curves" or "spectral signatures." Differences among spectral signatures are used to help classify remotely sensed images into classes of landscape features since the spectral signatures of like features have similar shapes. The figure below shows differences in the spectral response curves for healthy versus stressed sugar beet



plants. T

he more detailed the spectral information recorded by a sensor, the more information that can be extracted from the spectral signatures. Hyperspectral sensors have much more detailed signatures than multispectral sensors and thus provide the ability to detect more

subtle differences in aquatic and terrestrial features.

1.9 Spectral Reflectance of Land Covers

Spectral reflectance is assumed to be different with respect to the type of land cover, as explained in 1.3 and 1.8. This is the principle that in many cases allows the identification of land covers with remote sensing by observing the spectral reflectance or spectral radiance from a distance far removed from the surface.

Figure 1.9.1 shows three curves of spectral reflectance for typical land covers; vegetation, soil and water. As seen in the figure, vegetation has a very high reflectance in the near infrared region, though there are three low minima due to absorption.

Soil has rather higher values for almost all spectral regions. Water has almost no reflectance in the infrared region.

Figure 1.9.2 shows two detailed curves of leaf reflectance and water absorption. Chlorophyll, contained in a leaf, has strong absorption at 0.45 μm and 0.67 μm, and high reflectance at near infrared (0.7-0.9 μm). This results in a small peak at 0.5-0.6 (green color band), which makes vegetation green to the human observer.

Near infrared is very useful for vegetation surveys and mapping because such a steep gradient at 0.7-0.9 μm is produced only by vegetation.

Because of the water content in a leaf, there are two absorption bands at about 1.5 μm and 1.9 μm. This is also used for surveying vegetation vigor.

Figure 1.9.3 shows a comparison of spectral reflectance among different species of vegetation.

Figure 1.9.4 shows various patterns of spectral reflectance with respect to different rock types in the short wave infrared (1.3-3.0 μm). In order to classify such rock types with different narrow bands of absorption, a multi-band sensor with a narrow wavelength interval is to be developed. Imaging spectrometers (see 2.12) have been developed for rock type classification and ocean color mapping.

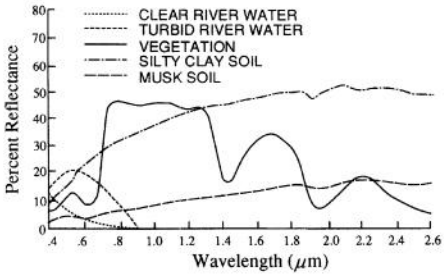


Figure 1.9.1 Spectral reflectance of vegetation, soil and water

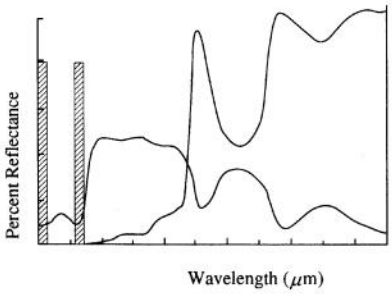


Figure 1.9.2 Spectral reflectance of a green leaf

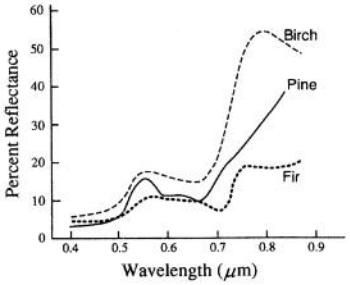


Figure 1.9.3 Spectral reflectance of different kind of plants

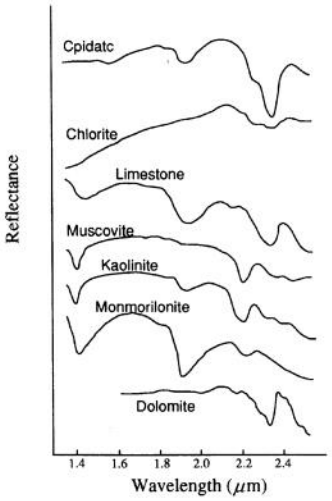


Figure 1.9.3 Spectral reflectance of rocks and minerals

2. Explain the principle of working of remote sensing?

3. With a suitable diagram explain the Electromagnetic Spectrums and its characteristics used in remote sensing?

4. Explain on the different types of interactions of EMR with atmosphere?

PLATFORMS AND SENSORS PART A

1.What is passive sensors?

Passive sensors can only be used to detect energy when the naturally occurring energy is available. For all reflected energy, this can only take place during the time when the sun is illuminating the Earth. There is no reflected energy available from the sun at night. Energy that is naturally emitted (such as thermal infrared) can be detected day or night, as long as the amount of energy is large enough to be recorded.

2.What is Active sensors?

On the other hand, provide their own energy source for illumination. The sensor emits radiation which is directed toward the target to be investigated. The radiation reflected from that target is detected and measured by the sensor.

3.Write the advantages of active sensors?

Advantages for active sensors include the ability to obtain measurements anytime, regardless of the time of day or season. Active sensors can be used for examining wavelengths that are not sufficiently provided by the sun, such as microwaves, or to better control the way a target is illuminated. However, active systems require the generation of a fairly large amount of energy to adequately illuminate targets. Some examples of active sensors are a laser fluorosensor and a synthetic aperture radar (SAR).

4. What are the types of Platforms?

The vehicle or carrier for remote sensor is borne is called the Platform." The typical platforms are satellite and aircraft, but they can also include radio controlled airplanes, balloons, pigeons, and kites for low altitude remote sensing, as well as ladder and cherry pickers for ground investigation.

5.Differentiate Geostationary orbit and Polar sun synchronous orbit.

Geostationary orbit

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High altitude (36,000km)
Remains in same position above the Earth
Used by meteorological and communications satellites
Sees Earth disk (between third and quarter of Earths surface)
High temporal frequency (c.30 mins typical)

Polar sun synchronous orbit

Low altitude (200-1000km)
Goes close to poles
Higher spatial resolution than geostationary
Lower temporal resolution than geostationary

6. What is Resolution?

In general resolution is defined as the ability of an entire remote-sensing system, including lens antennae, display, exposure, processing, and other factors, to render a sharply defined image.It is the resolving power of the sensor to detect the smallest meaningful elemental area in different spectral bands in s defined gray level at a regular interval.

7.What are the elements of resolution?

The four elements of resolutions are Spatial, Spectral, Radiometric and Temporal.

8. Write short notes about Spatial resolution.

It is the minimum elemental area the sensor can detect or measure. The resolution element is called pixel (picture element).

Example: IRS LISS 1-72.5m; LISS II-36.25m
Land sat MSS-80m; Land sat TM-30m
SPOT MSS HRV-120m; SPOT MSS HRV II-10m

9. Write short notes about Spectral resolution.

It refers to the sensing and recording power of the sensor in different bands of EMR. The sensors can observe an object separately in different bands or colors.

Examples: IRS-4 bands; Land sat MSS-4 bands; Land sat MSS TM-7 bands SPOT-4 bands

It is the ability if the sensor to distinguish the finer variation of the reflected radiation from different objects.

10. Write short notes on Radiometric resolutions.

It is the smallest amount of energy that can be detected by sensor and differentiate the same in a defined scale. It is recorded in digital number (DN) for different bands of the satellite. The radiometric value of the pixel is the average of the values coming from every part of the pixel.

Example: IRS-128 gray level; Land sat MSS-64; Land sat TM-256; SPOT-256(it is to be noted that '0'is also a value in the gray scale).

11. Write short notes on Temporal resolution.

It is the time interval between two successive surveys of a particular place of the earth by the sensor or satellite.

Examples: IRS-22days; Land sat 16/18days; SPOT-16days.

12. Write the types of Microwave Sensors?

Active microwave sensors are generally divided into two distinct categories: **imaging and non-imaging**. The most common form of imaging active microwave sensors is RADAR.

13.What is RADAR?

RADAR is an acronym for **RA**dio **D**etection **A**nd **R**anging, which essentially characterizes the function and operation of a radar sensor. The sensor transmits a microwave (radio) signal towards the target and detects the backscattered portion of the signal.

14. What are the types of DATA products?

The data for all the sensors of IRS -1C/1D are supplied on digital media like

a) Computer copatible tapes (CCTs)
b) Cartridge tapes
c) Floppies
d) CD-ROM products

PART B

1.What is resolution of a sensor? Describe all sensor resolutions.

2.Write short notes on the Indian remote sensing programme.

3.What is the role of a scanner in remote sensing and describe the different types of scanners used in remote sensing.

4.Discuss the thermal infrared in remote sensing?

5. Give details and examples about platforms and sensors.

6. What are the two type of sensors and discuss detail?

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UNIT III

IMAGE INTERPRETATION AND ANALYSIS

PART A

1.What is image interpretation?

Image interpretation is defined as the extraction of qualitative and quantitative information in the form of a map, about the shape, location, structure, function, quality, condition, relationship of and between objects, etc. by using human knowledge or experience.

2. What are all the Types of image interpretation?

Photo interpretation photographic interpretation and image interpretation are the terms used to interpret the Visual Image Interpretation.

3. What is Visual Image interpretation?

Visual Image interpretation is the act of examining photographs/images for the purpose of identifying objects and judging their significance"

4. What is Photo interpretation?

Photo interpretation is defined as the process of identifying objects or conditions in aerial photographs and determining their meaning or significance.

4.What is image reading?

Image reading is an elemental form of image interpretation. It corresponds to simple identification of objects using such elements as shape, size, pattern, tone, texture, color, shadow and other associated relationships. Image reading is usually implemented with interpretation keys with respect to each object .

5.What is image measurement?

Image measurement is the extraction of physical quantities, such as length, location, height, density, temperature and so on, by using reference data or calibration data deductively or inductively.

6. What is image analysis?

Image analysis is the understanding of the relationship between interpreted information and the actual status or phenomenon, and to evaluate the situation.

7. What is thematic map?

Extracted information will be finally represented in a map form called an interpretation *map or a thematic map.*

8. What are the Image interpretation elements ?

The eight elements of image interpretation are shape, size, tone, shadows, texture, site, pattern and association.

9. What is Digital Image Processing?

Digital Image Processing is a collection of techniques for the manipulation of digital images by computers. The raw data received from the imaging sensors on the satellite platforms contains flaws and deficiencies. To overcome these flaws and deficiencies in order to get the originality of the data, it needs to undergo several steps of processing. This will vary from image to image depending on the type of image format, initial condition of the image and the information of interest and the composition of the image scene.

10. What are the general steps of image processing?

The three steps of image processing are ,

- Pre-processing
- Display and enhancement
- Information extraction

11.Write about pre processing?

In the preprocessing ,prepare data for subsequent analysis that attempts to correct or compensate for systematic errors.

12. What is Image Enhancement?

The *o*perations are carried out to improve the interpretability of the image by increasing apparent contrast among various features in the scene. The enhancement techniques depend upon two factors mainly l The digital data (i.e. with spectral bands and resolution)

14. Write the objectives of interpretation?

The objectives of interpretation as an image enhancement technique often drastically alters the original numeric data, it is normally used only for visual (manual) interpretation and not for further numeric analysis. Common enhancements include image reduction, image rectification, image magnification, transect extraction, contrast adjustments, band ratioing, spatial filtering, Fourier transformations, principal component analysis and texture transformation.

15.What is digital image?

Digital Image is the matrix of "Digital Numbers". A digital image is composed of thousands of pixels. Each pixel represents the brightness of small region on the earth surface.Digital Image processing involves the manipulation and interpretation of digital image with the aid of computer.

16.What is filtering?

Filtering means the smoothening of an image using different Masks or Kernels.\

17.What is spatial filtering?

" Spatial Filtering can be described as selectively emphasizing or suppressing information at different spatial scales over an image. "

Spatial operation consists in changing the values of each pixels according to the values of the pixels in the neighborhoods.

18.What is convolution?

A convolution is an integral which expresses the amount of overlap of one function *g* as it is shifted over another function *f*. "

PART B

1.Write a detailed description on the elements of visual interpretation quoting suitalble examples for each.

2.Give a detailed description on the how the flaws and deficiency in remote sensing data can be removed.

3.Describe the different digital image processing techniques used.

4.Give a deatailed description on image classification and analysis of a remotely sensed data.What is the use of classifying image.

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UNIT IV
GEOGRAPHIC INFORMATION SYSTEM

1.What is map?

A map is usually considered to be a drawing to scale of the whole or a part of the surface of the earth on a plane surface; it is a manually or mechanically drawn picture of the earth showing the location and distribution of various natural and cultural phenomena.A map is a symbolic representation of an area.

2.Write the two types of maps?

The two maps are topographical and thematic maps.

3.Write about topographical map?

It is a reference tool, showing the outlines of selected natural and man-made features of the Earth

- often acts as a frame for other information

"Topography" refers to the shape of the surface, represented by contours and/or shading, but topographic maps also show roads and other prominent features.

4.Write about thematic map?

It is a tool to communicate geographical themes such as, the distribution of population & densities, climatic variables and land use etc.

5.What are the thematic maps in GIS?

a) choropleth map
b) area class map
c) isopleth map

6.What are the characteristics of map?

- maps are often stylized, generalized or abstracted, requiring careful interpretation
- usually out of date
- show only a static situation - one slice in time
- often highly elegant/artistic
- easy to use to answer certain types of questions:
  - how do I get there from here?
  - what is at this point?
- difficult or time-consuming to answer other types:
  - what is the area of this lake?
  - what places can I see from this TV tower?
  - what does that thematic map show at the point I'm interested in on this topographic map?

7.Write the necessity of map projection?

Projection is necessary one because spatial entities locate in two dimensions. The method by which the "world is laid flat" is use to help projection. Doing the process introduce error into spatial data. Spatial data character varies depending on the projection method chosen. Shape and distance are distorted the accuracy world is spherical shape visualize the two dimension in flat surface is difficult.

8.Write the types of map projection?

1.Cylindrical projection 2. Azimuthal projection
3. Conical projection

9.Write few lines about cylindrical projection?

Countries near the equator in true relative portion
Distance increases between countries located towards top and bottom of mage.
The view of the poles is very distorted
Area for the most part is preserved

10.Write few lines about conical projection?

Area is distorted.
Distance is very distorted towards the bottom of the image.
Scale for the most part is preserved

11.Write few lines about azimuthal projection?

Only a part of the earth surface is visible.

The view will be of half the globe or less.

Distortion will occur at all four edges.

Distance for the more part is preserved.

12.What is referencing system?

Referencing system is used to locate a feature on the earth's surface or a two dimension representation of this surface such as a map.

13.What are the methods of spatial referencing systems?

Several methods of spatial referencing exist all of which can be grouped into three categories.

Geographical co-ordinate system
Rectangular co-ordinate system
Non-co-ordinate system

14. What is Geographic Co-Ordinate System?

This is a one of true co-ordinate system .the location of any point on the earth surface can be defined by a reference using latitude and longitude.

15.What is QTM?

The quaternary triangular mesh refrenshing system tries to deal with irregularities in the earth surface.

16.What is GIS?

It's a computer based information system primarily aims in collecting, classifying, crosschecking, manipulating, interpreting, retrieving and displaying data which are spatially referred to the earth in an appealing way.

17.What are the components of GIS?

i) The Computer System (Hardware and Operating System)
ii) The Software
iii) Spatial Data
iv) Data Management and analysis procedures
v) The People to operate the GIS

18.What are the GIS softwares used?

Standard GIS Softwares

- ARCGIS
- ARCVIEW
- ARCINFO
- MAPINFO
- ERDAS
- ENVI
- AUTOCADMAP
- IDRISI

PART B

1.What is map projection and explain the differentiate types of map projections with their characteristics.
2.Explain in detail on the different types of data utilized in GIS technology.
3.Explain the different classification of maps.
4.Explain DBMS ,with emphasis on the differentiate types of DBMS used in GIS functioning.

UNIT V
DATA - ENTRY ,STORAGE AND ANALYSIS

1.What is Data model?

Data Models: Vector and Raster

Spatial data in GIS has two primary data formats: raster and vector.
Raster uses a grid cell structure, whereas vector is more like a drawn map.

Raster and Vector Data

Vector format has points, lines, polygons that appear normal, much like a map.

Raster format generalizes the scene into a grid of cells, each with a code to indicate the feature being depicted. The cell is the minimum mapping unit.

Raster has generalized reality: all of the features in the cell area are reduced to a single cell identity.

2.What is raster data?

Raster is a method for the storage, processing and display of spatial data. Each area is divided into rows and columns, which form a regular grid structure. Each cell must be rectangular in shape, but not necessarily square. Each cell within this matrix contains location co-ordinates as well as an attribute value. The origin of rows and column is at the upper left corner of the grid.

Rows function as the "y"coordinate and column as"x"coordinate in a two dimensional system. A cell is defined by its location in terms of rows and columns.

3.What is vector data?

- Vector data uses two dimensional Cartesian coordinates to store the shape of spatial entity. Vector based features are treated as discrete geometric objects over the space.
- In the vector data base point is the basic building block from which all the spatial entities are constructed.
- The vector spatial entity ,the point is represented by a single x,y coordinate pair. Line and area entities are constructed by a series of points into chains and

4. What is Raster?

The raster cell's value or code represents all of the features within the grid, it does not maintain true size, shape, or location for individual features. Even where "nothing" exists (no data), the cells must be coded.

5.What is Vector?

vectors are data elements describing position and direction. In GIS, vector is the map-like drawing of features, without the generalizing effect of a raster grid. Therefore, shape is better retained. Vector is much more spatially accurate than the raster format.

6.What is raster coding?

In the data entry process, maps can be digitized or scanned at a selected cell size and each cell assigned a code or value.

The cell size can be adjusted according to the grid structure or by ground units, also termed resolution.

There are three basic and one advanced scheme for assigning cell codes.

Presence/Absence: is the most basic method and to record a feature if some of it occurs in the cell space.

7. What is Cell Center?

The cell center involves reading only the center of the cell and assigning the code accordingly. Not good for points or lines.

8.What is Dominant Area?

To assign the cell code to the feature with the largest (dominant) share of the cell. This is suitable primarily for polygons.

9.What is Percent Coverage?

A more advanced method. To separate each feature for coding into individual themes and then assign values that show its percent cover in each cell.

10.Different methods of data input?

- Key board entry
  - O.C.R.
- Digitizing
  - Manual digitizing
  - Automatic digitizing
    - Scanning
    - Automatic line follower
- Electronic data transfer

11.What is digitizing?

The most common method employed in encoding data from a paper map.

- Manual digitizing
- Automatic digitizing

Scanning
Automatic line follower

12.Write the errors in digitizing?

Scale and resolution of the source/base map.
Quality of the equipment and the software used.
Incorrect registration.
A shaky hand.
Line thickness.
Overshoot.
Under shoot.
Spike.
Displacement.
Polygonal knot.
Psychological errors.

13.What is scanning?

piece of hard ware for converting an analogue source of document into digital raster format (a light sensitive device).
Most commonly used method.
When raster data are there to be encoded scanning is the most appropriate option.
There are three different types of scanners available in usage :-

Flat-bed scanners (a PC peripheral).
Rotating drum scanners.
Large format feed scanners

14.Write the important components of scanner?

A light source.
A back ground.
A lens.

15.Write the practical problems in scanning?

Possibility of optical distortion associated with the usage of flat bed scanners.
Automatic scanning of unwanted information.
Selection of appropriate scanning tolerance to ensure important data are encoded, and background data ignored.
The format of files produced and the input of data into G.I.S. software.
The amount of editing required to produce data suitable for analysis.

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PART B

1.What is data model ?Enumerate different types of GIS data.
2.Write short notes on:
(i) Overlaying
(ii) Buffering and GIS
3.What are the possible techniques best adopted for better storage of raster data that would avoid repetition of characters.
4.Explain on the different methods of data input in GIS.