18CE502

Hall Ticket Number

III/IV B. Tech (Regular) Degree Examination (2020-21)

February - 2021 **Civil Engineering**

Fifth Semester **REMOTE SENSING & GIS APPLICATIONS**

Time: Three Hours Maximum: **50 Marks**

Answer Question No. 1 compulsory. (1 x 10 =10 Marks)

Answer ONE Question from each unit. (4 x 10 = 40 Marks)

1) Answer all questions **1*10=10M**

a) **Define photogrammetry?** **(CO1)**
b) **What is photogrammetry overlap?** **(CO1)**
c) **What are remote sensing sensors?** **(CO2)**
d) **What are the different characteristics of satellite orbit?** **(CO2)**
e) **What are the different platforms used for remote sensing?** **(CO2)**
f) **WHAT IS OVERLAY?** **(CO3)**
g) **What is buffering?** **(CO3)**
h) **Define GIS?** **(CO3)**
i) **What are components of GPS?** **(CO4)**
j) **Definition of GPS?** **(CO4)**

2) With neat sketches explain the fundamentals of photogrammetry and also write its types. (CO1) **10M**

(OR)

3) Explain in detail about stereoscopy? (CO1) **10M**

4) Briefly explain about the overview of Indian remote sensing satellites. (CO2) **10M**

(OR)

5) a) Explain the energy interactions with target. (CO2) **5M**
b) Explain the techniques of visual interpretation techniques. (CO2) **5M**

6) With neat sketches explain the RASTER & VECTOR GIS? Compare its relative merits and demerits. (CO3) **10M**

(OR)

7) Explain about network analysis and write its application? (CO3) **10M**

8) Explain the use of GIS in physical transformation of urban land. (CO1) **10M**

(OR)

9) a) Explain in detail about the land use/land cover in water resources? (CO4) **5M**
b) Explain the applications of GPS (CO4) **5M**

SCHEME

III/IV B.TECH REGULAR DEGREE EXAMINATION 2020-21

DEPARTMENT: CIVIL ENGINEERING
SUBJECT NAME: REMOTE SENSING AND GIS APPLICATIONS
SUBJECT CODE: 18CE502
PREPARED BY: S.SURESH KUMAR (8977812369)

1) Answer all questions **1*10=10M**

a) Define photogrammetry?

It is the science and technology of making measurements using photographs.

b) What is photogrammetry overlap?

It is the amount by which one photograph includes the area covered by another photograph and is expressed as a percentage. Usually 60% forward overlap (along same line) and 30% along lateral overlap.

c) What are remote sensing sensors?

A remote sensor is a device that measures and records electromagnetic energy emitted by the target. Sensors can be divided into two categories i.e. active sensors and passive sensors.

d)What are the different characteristics of satellite orbit?

Orbit, swath, overlap, apogee, perigee, altitude, Inclination etc.

e) What are the different platforms used for remote sensing?

Ground based, air based and space based

f) WHAT IS OVERLAY?

Overlay is a GIS operation that superimposes multiple data sets (representing different themes) together for the purpose of identifying relationships between them. An overlay creates a composite map by combining the geometry and attributes of the input data sets. Tools are available in most GIS software for overlaying both Vector and raster data.

g) What is buffering?

A buffer is zone around a map feature measured in units of distance or time. It is useful in proximity analysis.

h) Define GIS?

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.

i) What are components of GPS?

Space segment, control segment, user segment.

j) Definition of GPS?

GPS is the space based satellite navigation system provides location and time information in all weather conditions.

2) Aerial photography refers to taking photograph of earth surface from space. Platform of aerial photography includes aircraft, helicopter, balloon, parachute etc.

The characteristics of aerial photography that make it widely popular are:

a) **Synoptic view point**
b) Time freezing ability
c) Capability to stop action
d) Spectral resolution and spatial resolution
e) **Three dimensional perspectives**
f) Availability
g) **Economy**
h) Types of Aerial Photos

Aerial photos can be distinguished depending on the position of camera axis with respect to the vertical and motion of the aircraft. Aerial photographs are divided into two major groups, vertical and oblique photos.

i) Vertical photos: The optical axis of the camera or camera axis is directed vertically as straight down as possible The nadir and central point of the photograph are coincident. But in real a truly vertical aerial photograph is rarely obtainable because of unavoidable angular rotation or tilts of aircraft. The allowable tolerance is usually +3° from the perpendicular (plumb) line to the camera axis. Vertical photographs are taken for most common use in remote sensing and mapping purposes.

A vertical photograph has the following characteristics:

(1) The camera axis is perpendicular to the surface of the earth.
(2) It covers relatively small area than oblique photographs.
(3) The shape of the ground covered on a single vertical photo closely approximates a square or rectangle.
(4) Being a view from above, it gives an unfamiliar view of the ground.
(5) Distance and directions may approach the accuracy of maps if taken over flat terrain.
(6) Relief is not readily apparent.

ii) Oblique photos: When the optical of the camera forms an angle of more than 50 with the vertical, oblique photographs are obtained. The nadir and central point of the photograph are not coincident.

There are two types of oblique aerial photography – high angle and low angle. In high angle oblique aerial photography the resulting images shows the apparent horizon and in low angle oblique photograph does not. Oblique photographs can be useful for covering very large areas in a single image and for depicting terrain relief and scale. A square outline on the ground appears as a trapezium in oblique aerial photo.

An oblique photograph has the following characteristics:
(1)Low oblique photograph covers relatively small area than high oblique photographs.
(2)The ground area covered is trapezoid, but the photograph is square or rectangular. Hence scale is not applicable and direction (azimuth) also cannot be measured.
(3)The relief is discernible but distorted.

Fig. 7.2. Vertical and oblique photography.

Aerial photographs are taken using a camera fitted at the bottom of a aircraft along a line is termed as flight line or flight strips and the line traced on ground directly beneath the camera is called nadir line. The point on photograph where the nadir line meets the ground is termed as principal point. Lines drawn to connect marks located along opposite sides of the photo (fiducial marks) intersect precisely at the principal point. The point on the photo that falls on a line half- way between the principal point and the Nadir point is known as isocenter. The ground distance between the photo centers (principal points) is called air base.

In aerial photography, the aircraft acquires a series of exposures along each strip of multiple flight lines. Successive photographs are generally taken with some degree of overlap, which is known as endlap (Fig. 7.4). Standard endlap is 60%, which may be 80-90% in special cases such as in mountainous terrain. It ensures that each point of the ground appears in at least two successive photographs essential for stereoscopic coverage.

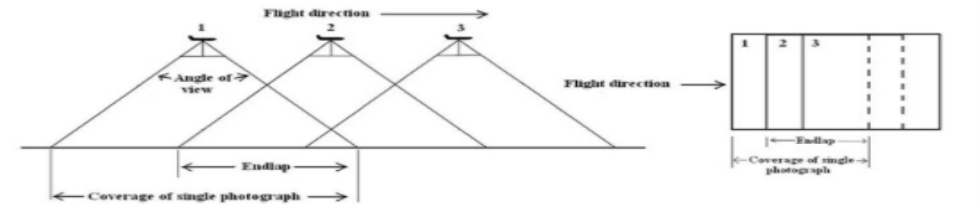


Fig. 7.4. Photographic coverage along flight line: endlap.

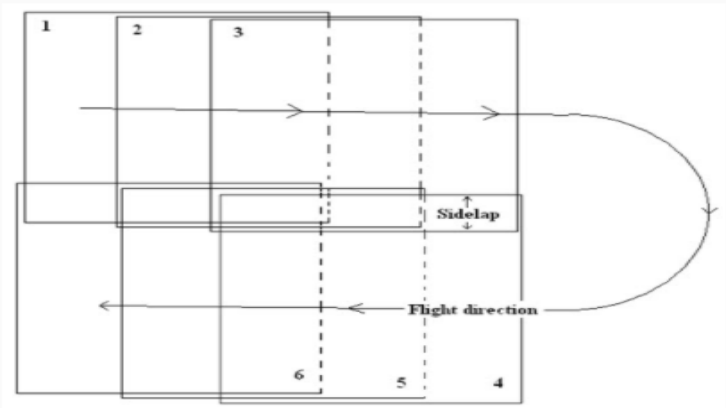


Fig. 7.5. Positions of aerial photos: sidelap.

3) Stereoscopy, is a technique used to enable a three dimensional effect, adding an illusion of depth to a flat image. In aerial photography, when two photographs overlap or the same ground area is photographed from two separate position forms a stereo-pair, used for three dimension viewing. Thus obtained a pair of stereoscopic photographs or images can be viewed stereoscopically. A stereoscope facilitates the stereo viewing process by looking at the left image with the left eye and the right image with the right eye. It is based on Porro-Koppe's Principle that the same light path can be generated in an optical system if a light source is projected onto the image taken by an optical system. Stereoscopic vision is constructed with a stereo pair images using the relative orientation or tilt at the time of photography. Stereo viewing allows the human brain to judge and perceive in depth and volume. 3D representation of the earth's surface resulting in the collection of the geographic information with a greater accuracy compared to the monoscopic techniques.

A stereoscope is used in conjunction with two aerial photographs taken from two different positions of the same area, (known as a stereo-pair) to produce a 3-D image. There are two types of stereoscopes: lens (or pocket) stereoscope and mirror stereoscope. Lens (or pocket) stereoscope has a limited view and therefore restricts the area that can be inspected where as in mirror stereoscope has wide view and enables a much larger area to be viewed on the stereo-pair. The most obvious feature when using a stereoscope is the enhanced vertical relief. This occurs because our eyes are only 65mm apart, but the air photos may be taken at 100s of meters apart, hence the difference in exposures is far greater than the difference between our eyes. Such an exaggeration also enables small features to become quite apparent and easily viewed.

As an example, in two photographs overlap the same region, in which objects A, B and C are situated at the same altitude and object D at a different altitude, the four objects will be observed in a different sequence in the two photographs a, b, d, c in the left photograph and a, d, b, c in the right (Fig. 8.2). In the same photograph, segments ab and bc are equal since they are at the same altitude, but segments ad and dc are not

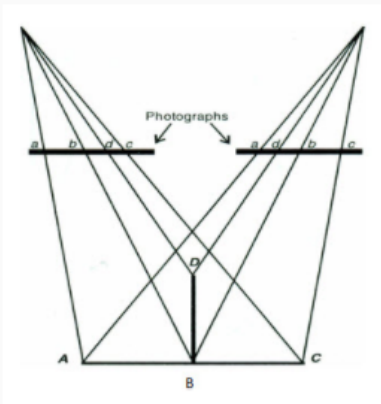


Fig. 8.2. Perception of relief from two aerial photographs.

$P_a = x_a + x_a'$ and $P_b = x_b + x_b'$

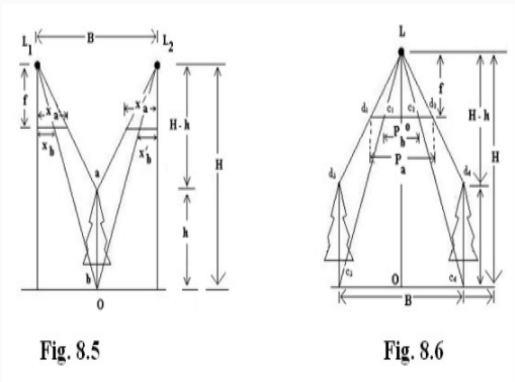


Fig. 8.5 Fig. 8.6

Parallax and Altitude Determination

In two successive photos taken in position L1 and L2 separated by a distance equal to the air base B, and the object height is h; a and b are the top and bottom of the object (Fig. 8.5). B is the photo-base i.e. the distance between two successive exposures. For the convenience of the calculation, Figure 8.5 is transferred to Figure 8.6. Point a and b are projected on the joint photograph as xa, xa' and xb, xb' correspondingly (Fig. 8.5). The parallax of point a and b are Pa and Pb respectively. To represent

this parallax, a pseudo-image is drawn at the focal distance of the camera. The parallax of point a and b is Pa and Pb.

4)

Table 8. Details of the various satellites of the IRS satellite program

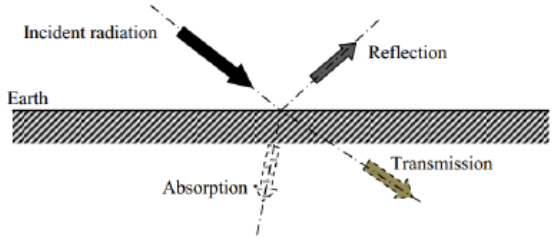
Satellite	IRS-1A	IRS-1B	IRS-1C	IRS-1D	IRS-P2	Cartosat-2	Resourcesat-2
Period	1988-1996	1991-2003	1995-2007	1997-2010	2003-	2007-	2011-
Orbit	Sun-synchronous, Polar						
Eq. crossing	10:30am						
Altitude	904		817		817	630	822
Inclination	99.08		98.6		98.7	97.91	98.73
Repeat cycle (days)	22		24		24 LISS-4 and AWiFS : 5	310 Revisit: 4	24
Sensors	LISS-1, LISS-2A and 2B		PAN, LISS-3, WiFS		LISS-3 and 4, AWiFS	PAN camera	LISS-3 and 4, AWiFS
Bands	B1-B4		PAN, LISS-3 B1-B4 WiFS B1-B2		LISS-3 B1-B4 LISS-4 B1-B3 AwiFS B1-B4	PAN (0.5-0.85μm)	LISS-3 B1-B4 LISS-4 B1-B3 AwiFS B1-B4
Spatial resolution	72.5m	36.25m	PAN:5.8m LISS-3: 23m (B4:70m)		LISS-3:23.5 LISS-4: 5.8 AWiFS: 56m	0.81m	LISS-3:23.5 LISS-4: 5.8 AWiFS: 56m
Radiometric resolution (Bits)	7	7	7	7	LISS-3 and 4: 7 AwiFS: 10	10	LISS-3 and 4: 10 AwiFS: 12

Table 7. Spectral bands used in various sensors of the IRS satellites

Sensor	LISS-1 and 2	LISS-3	LISS-4	WiFS	AWiFS
Wavelength	0.45-0.52	0.52-0.59	0.52-0.59	0.62-0.68	0.52-0.59
bands (μm)	0.52-0.59	0.62-0.68	0.62-0.68	0.77-0.86	0.62-0.68
	0.62-0.68	0.77-0.86	0.77-0.86		0.77-0.86
	0.77-0.86	1.55-1.70			1.55-1.70

5)a) Energy incident on the Earth's surface is absorbed, transmitted or reflected depending on the wavelength and characteristics of the surface features (such as barren soil, vegetation, waterbody). Interaction of the electromagnetic radiation with the surface features is dependent on the characteristics of the incident radiation and the feature characteristics. After interaction with the surface features, energy that is reflected or re-emitted from the features is recorded at the sensors and are analysed to identify the target features, interpret the distance of the object, and /or its characteristics. Reflection occurs when radiation is redirected after hitting the target.

According to the law of reflection, the angle of incidence is equal to the angle of reflection



Reflection occurs when radiation is redirected after hitting the target. According to the law of reflection, the angle of incidence is equal to the angle of reflection

Absorption occurs when radiation is absorbed by the target. The portion of the EM energy which is absorbed by the Earth's surface is available for emission and as thermal radiation at longer wavelengths

Transmission occurs when radiation is allowed to pass through the target. Depending upon the characteristics of the medium, during the transmission velocity and wavelength of the radiation changes, whereas the frequency remains same. The transmitted energy may further get scattered and / or absorbed in the medium. These three processes are not mutually exclusive. Energy incident on a surface may be partially reflected, absorbed or transmitted. Which process takes place on a surface depends on the following factors:

Wavelength of the radiation

Angle at which the radiation intersects the surface

Composition and physical properties of the surface

5)b) Analysis of remote sensing imagery involves the identification of various targets in an image, and those targets may be environmental or artificial features, which consist of points, lines, or areas. This radiation is measured and recorded by a sensor, and ultimately is depicted as an image product such as an Observing the differences between targets and their backgrounds involves comparing different targets based on any, or all, of the visual elements of

Tone refers to the relative brightness or colour of objects in image. Generally, tone is the Fundamental element for distinguishing between different targets or features.

Shape refers to the general form, structure, or outline of individual objects. Shape can be a very distinctive clue for interpretation.

Size of objects in an image is a function of scale. It is important to assess the size of a target relative to other objects in a scene, as well as the absolute size, to aid in the interpretation of that target.

Pattern refers to the spatial arrangement of visibly discernible objects. Typically an orderly Repetition of similar tones and textures will produce a distinctive and ultimately recognizable pattern.

Texture refers to the arrangement and frequency of tonal variation in particular areas of an image. Rough textures would consist of a mottled tone where the grey levels change abruptly in a small area, Smooth textures are most often result of uniform, even surfaces.

Shadow is also helpful in interpretation as it may provide an idea of the profile and relative height of a target or targets which may make identification easier.

Association takes into account the relationship between other recognizable Objects or features in proximity to the target of interest.

6) GIS data can be separated into two categories:

Spatially referenced data which is represented by vector and raster forms (including imagery)

Attribute data tables which is represented in tabular format.

Within the spatial referenced data group, the GIS data can be further classified into two different types:

vector data

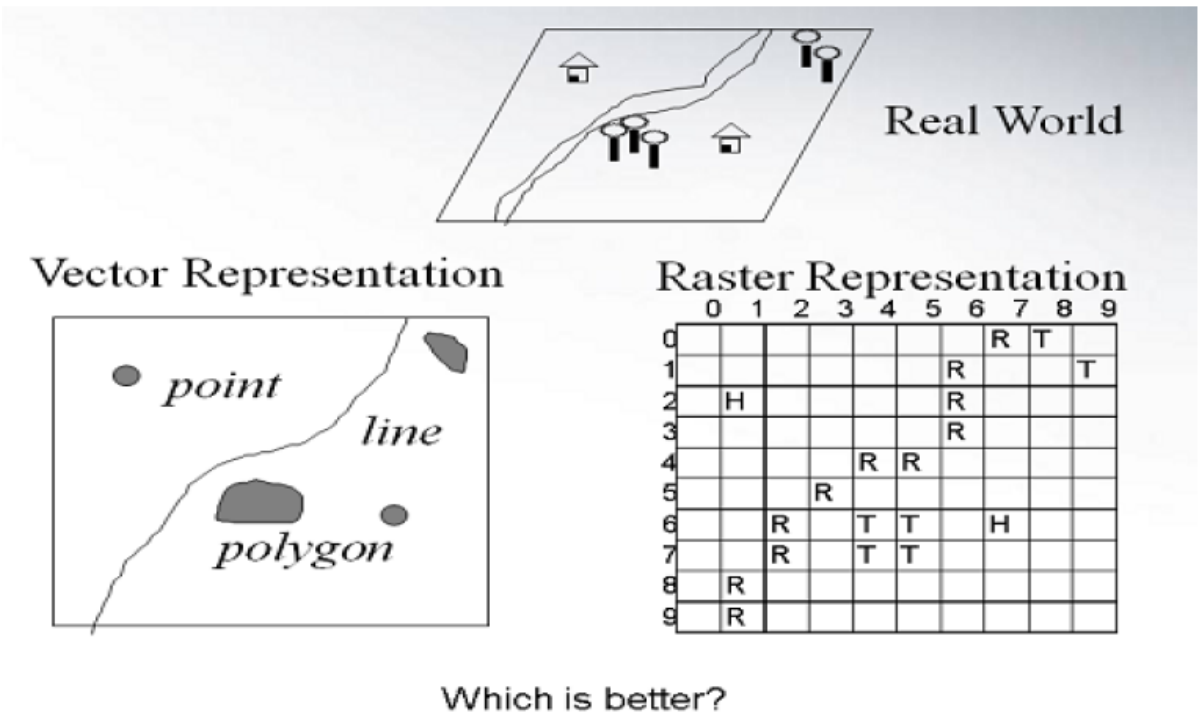
raster data

Vector data

Vector data is split into three types: polygon, line (or arc) and point data. Polygons are used to represent areas such as the boundary of a city (on a large scale map), lake, or forest. Polygon features are two dimensional and therefore can be used to measure the area and perimeter of a geographic feature.

Raster Data

Raster data (also known as grid data) represents the fourth type of feature: surfaces. Raster data is cell-based and this data category also includes aerial and satellite imagery. There are two types of raster data: continuous and discrete. An example of discrete raster data is population density. Continuous data examples are temperature and elevation measurements. There are also three types of raster datasets: thematic data, spectral data, and pictures (imagery).



ADVANTAGES

Raster
-simple data structures
-cheap technology
-raster analysis is simple
-same grid cells for attributes
-can display remotely sensed data
-layer overlays are fast & simple
-gathering raster data from scanning or remotely sensed images are cheap & fast
Vector
-good representation of data
-use small file size
-accurate map output
-compact data structures
-maps are aesthetically pleasing

7) Network analyses involve analysing the flow of networks—a connected set of lines and point nodes (sometimes called centres or hubs). These linear networks most often represent features such as rivers, transportation corridors (roads, railroads, and even flight paths), and utilities (electric, telephone, television, sewer, water, gas). Point nodes usually represent pickup or destination sites, clients, transformers, valves, and intersections. People, water, consumer packages, kilowatts, and many other resources flow to and from nodes along linear features. Each linear feature affects the resource flow. For example, a street segment might only provide flow in one direction (a one-way street) and at a certain speed. Nodes can also affect flow. A stuck valve might allow too much of a resource to stream out and away from its intended destination. Network analysis tools help you analyse the "cost" of moving through the network. Like spread functions, "cost" can represent money, time, distance, or effort. Network analyses are vector-based applications, but there are similarities with raster-based spread functions. The three major types of network analyses include route selection (optimal path or shortest path), resource allocation, and network modelling.

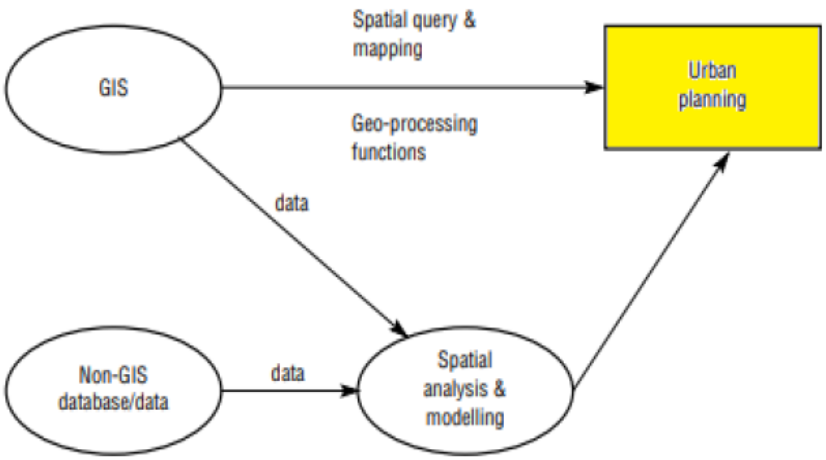
Route Selection attempts to identify the least "cost" route. As described above, cost can be defined a number of ways. You might want to find the
Shortest path between your home and a weekend destination or the least costly route that delivers UPS packages to their recipients. In any route selection
Routine, two or more nodes, including an origin and a destination point, must be identified and be able to be visited on the network. Sometimes there are a
Large number of possible routes. It is the job of the network analysis algorithm to determine the least cost route. Multiple paths are tested until the least
Cost path connects the starting and destination points.

Resource Allocation, the second major type of network analysis, involves the apportionment of a network to nodes. To do this, you define one or more
Allocation nodes on the network. Territories of linear features, like streets, are defined around each of these allocation nodes. The linear features are
Usually assigned to the nearest node, where distance is measured in time, length, money, or effort. Figure 5.21 depicts 4-minute response times from six
Fire stations and three potential fire station locations. The polygon that is drawn around each station (triangle) represents the area that can be covered in 4minutes

Network Modelling uses interconnected linear features and point nodes to analyse how resources travel through networks. The linear features, like streets
Or river channels, have attributes that might define travel speed, number of lanes, and volume of flow. Nodes also have attributes that might identify Vehicular turns and the time or cost required for each turn. Resources like water or traffic are placed in the network and their movement modelled. This Way, problems with the network load can be identified.

8) GIS provides planners, surveyors, and engineers with the tools they need to design and map their neighbourhoods and cities. Visualization, spatial analysis, and spatial modelling are the most frequently used GIS functions in plan making. GIS can help to store, manipulate, and analyse physical, social, and economic data of a city. Planners can then use the spatial query and mapping functions of GIS to analyse the existing situation in the city. Through map overlay analysis, GIS can help to identify areas of conflict of land development with the environment by overlaying existing land development on land suitability maps.

- Using the multi-layered mapping feature of GIS, a municipal planning committee can visualize a variety of things, for instance, prime agricultural land, surface water, high flood frequency, and highly erodible land. This information leads to informed decisions such as avoiding developing areas with high flood frequency as those areas are not likely to attract dwellers.
- GIS can significantly aid in monitoring an area or conducting a feasibility study of a location for a specific purpose, for instance ascertaining the suitability of a location for the construction of a bridge or dam.
- Feasibility studies of smaller structures like schools and hospitals can also be carried out effectively using GIS. It can also be used to ascertain the feasibility of an area for waste disposal and treatment.
- GIS also helps in identifying changes in geographical features or behaviour a land over a specified time. Such information enables professionals to make informed decisions about the development condition of an area and plan accordingly.



9)a) Although the terms land cover and land use are often used interchangeably, their actual meanings are quite distinct.
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 the land serves, for example, recreation, wildlife habitat, or agriculture.

It is important to distinguish this difference between land cover and land use, and the information that can be ascertained from each. The properties measured with remote sensing techniques relate to land cover, from which land use can be inferred, particularly with ancillary data or a prior knowledge.
There are many different sources of information on existing land use and land cover and on changes that are occurring at different levels. Local planning agencies make use of detailed information generated during ground surveys involving enumeration and observation.
Major problems that surface during the application and interpretation of these data sets include changes in definitions of categories and data collection methods by source agencies, incomplete data coverage, varying data age, and employment of incompatible classification systems.
In addition it is nearly impossible to aggregate the available data because of the differing classification systems used. These limitations of traditional approaches had been partly overcome by adopting modern approaches like Remote Sensing.

9)b) APPLICATIONS

Student need to explain any these applications

- Navigation
- Automated vehicles
- Mining
- Missile guiding
- Military operations
- Canal routing
- Road network routing network
- Aircraft and fleet tracking