Govt. Engineering College Jhalawar
Model Question Paper
Subject- Remote Sensing & GIS

Time: **Max. Marks:**

Q1. What is remote Sensing? Explain the basic components of a Remote Sensing system.

Q2. What is Active & Passive Remote Sensing? Explain with the diagram.

Q3 Explain about the types of Remote Sensing Platforms.

Q4. What do you understand by Ideal Remote sensing system?

Q5.Write the advantages and disadvantages of Remote Sensing.

Q6 What is the difference between terrestrial and aerial photogrammetry?

Q7 At what heights do geostationary satellites operate?

Q8 What are the differences between images and photographs?

Q9. What is the wavelength of electromagnetic radiation which has a frequency of 5x1010 Hz ? What type of electromagnetic radiation has this wavelength? (C=3x108 m/s)

Q10.Why is clear non-turbulent water blue/green in the visible part of the spectrum and black near infrared?

Q11What are the two forms of selective scattering and how does selective scattering differ from non-selective scattering?

Q12.What is a false color image/composite (FCC) and how is it produced?

Answer 1

Remote sensing is an art and science of obtaining information about an object or feature without physically coming in contact with that object or feature. The data can be collected in many forms like variations in acoustic wave distributions (e.g., sonar), variations in force distributions (e.g., gravity meter), variations in electromagnetic energy distributions (e.g., eye) etc. These remotely collected data through various sensors may be analyzed to obtain information about the objects or features under investigation. In this course we will deal with remote sensing through electromagnetic energy sensors only.

According to American Society of Photogrammetry, remote sensing is the process of inferring surface parameters from measurements of the electromagnetic radiation (EMR) from the Earth's surface. This EMR can either be reflected or emitted from the Earth's surface. In other words, remote sensing is detecting and measuring electromagnetic (EM) energy emanating or reflected from distant objects made of various materials, so that we can identify and categorize these objects by class or type, substance and spatial distribution.

Remote sensing provides a means of observing large areas at finer spatial and temporal frequencies. It finds extensive applications in civil engineering including watershed studies, hydrological states and fluxes simulation, hydrological modeling, disaster management services such as flood and drought warning and monitoring, damage assessment in case of natural calamities, environmental monitoring, urban planning etc.

"Remote sensing is the science (and to some extent, art) of acquiring information about the Earth's surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information."

In much of remote sensing, the process involves an interaction between incident radiation and the targets of interest. This is exemplified by the use of imaging systems where the following seven elements are involved. Note, however that remote sensing also involves the sensing of emitted energy and the use of non-imaging sensors.

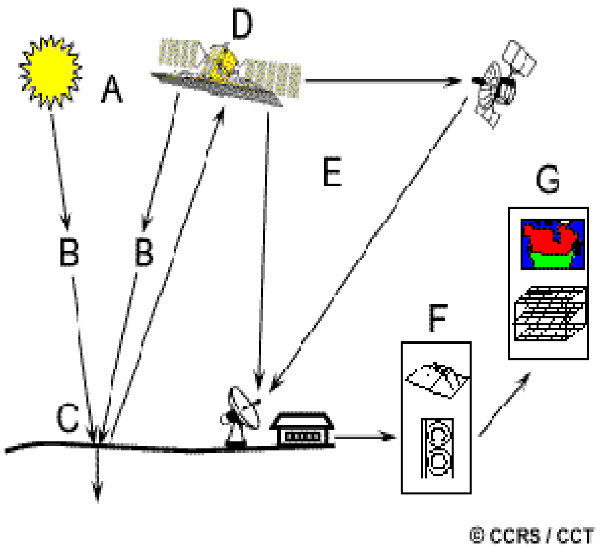

Fig Components of Remote Sensing

Components of Remote Sensing

These seven elements comprise the remote sensing process from beginning to end as shown in the above figure.

1. Energy Source or Illumination (A) – the first requirement for remote sensing is to have

an energy source which illuminates or provides electromagnetic energy to the target of interest.

2. Radiation and the Atmosphere (B) – as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor.

3. Interaction with the Target (C) - once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.

4. Recording of Energy by the Sensor (D) - after the energy has been scattered by, or emitted from the target, we require a sensor (remote - not in contact with the target) to collect and record the electromagnetic radiation.

5. Transmission, Reception, and Processing (E) - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).

6. Interpretation and Analysis (F) - the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.

7. Application (G) - the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

Answer 2

Active & Passive Remote Sensing

Depending on the source of electromagnetic energy, remote sensing can be classified as passive or active remote sensing.

In the case of passive remote sensing, source of energy is that naturally available such as the Sun. Most of the remote sensing systems work in passive mode using solar energy as the source of EMR. Solar energy reflected by the targets at specific wavelength bands are recorded using sensors onboard air-borne or space borne platforms. In order to ensure ample signal strength received at the sensor, wavelength / energy bands capable of traversing through the atmosphere, without significant loss through atmospheric interactions, are generally used in remote sensing

Any object which is at a temperature above 0^{o} K (Kelvin) emits some radiation, which is approximately proportional to the fourth power of the temperature of the object. Thus the Earth also emits some radiation since its ambient temperature is about 300^{o} K. Passive sensors can also be used to measure the Earth's radiance but they are not very popular as the energy content is very low.

In the case of active remote sensing, energy is generated and sent from the remote sensing platform towards the targets. The energy reflected back from the targets are recorded using sensors onboard the remote sensing platform. Most of the microwave remote sensing is done through active remote sensing.

As a simple analogy, passive remote sensing is similar to taking a picture with an ordinary camera whereas active remote sensing is analogous to taking a picture with camera having built-in flash

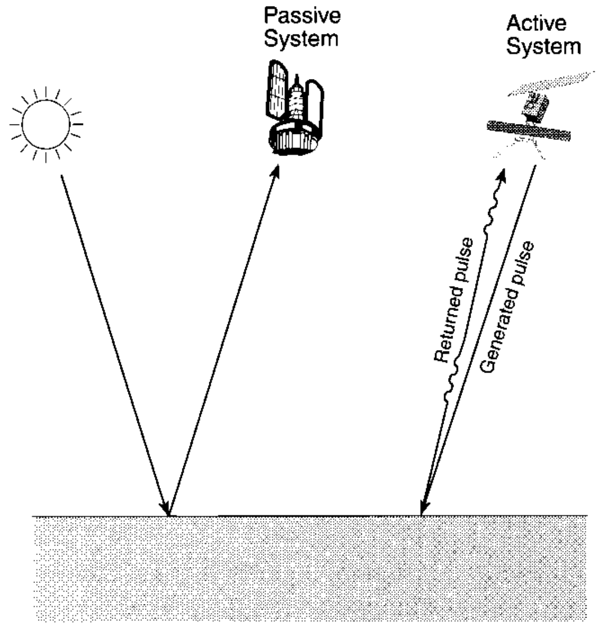

Fig. Schematic representation of passive and active remote sensing

<u>Answer 3</u>

Different Remote Sensing Platforms

Remote sensing platforms can be classified as follows, based on the elevation from the Earth's surface at which these platforms are placed.

- ☐ Ground level remote sensing
    - o Ground level remote sensors are very close to the ground
    - o They are basically used to develop and calibrate sensors for different features on the Earth's surface.
- ☐ Aerial remote sensing
    - o Low altitude aerial remote sensing
    - o High altitude aerial remote sensing
- ☐ Space borne remote sensing

- o Space shuttles
- o Polar orbiting satellites
- o Geo-stationary satellites

From each of these platforms, remote sensing can be done either in passive or active mode.

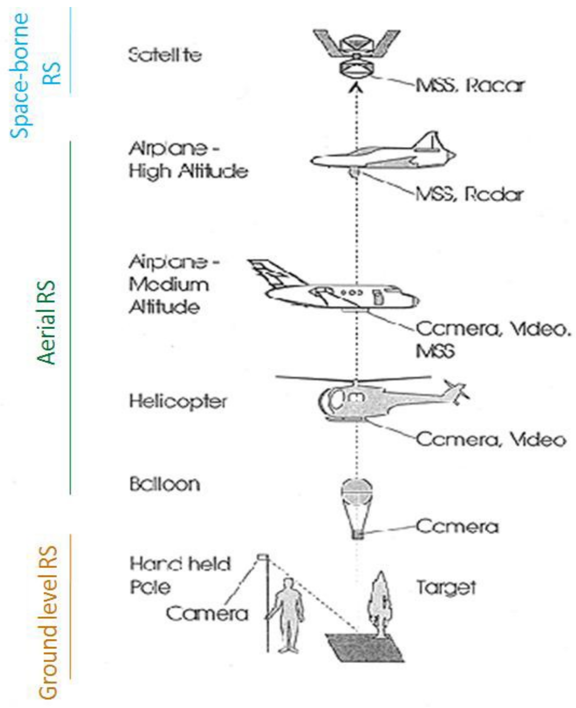

Fig. Different Remote sensing platforms

Airborne and Space-borne Remote Sensing

In airborne remote sensing, downward or sideward looking sensors mounted on aircrafts are used to obtain images of the earth's surface. Very high spatial resolution images (20 cm or less) can be obtained through this. However, it is not suitable to map a large area. Less coverage area and high cost per unit area of ground coverage are the major disadvantages of airborne remote sensing. While airborne remote sensing missions are mainly one-time operations, space-borne missions offer continuous monitoring of the earth features.

LiDAR, analog aerial photography, videography, thermal imagery and digital photography are commonly used in airborne remote sensing.

In space-borne remote sensing, sensors mounted on space shuttles or satellites orbiting the Earth are used. There are several remote sensing satellites (Geostationary and Polar orbiting) providing imagery for research and operational applications. While Geostationary or

Geosynchronous Satellites are used for communication and meteorological purposes, polar orbiting or sun-synchronous satellites are essentially used for remote sensing. The main advantages of space-borne remote sensing are large area coverage, less cost per unit area of coverage, continuous or frequent coverage of an area of interest, automatic/ semiautomatic computerized processing and analysis. However, when compared to aerial photography, satellite imagery has a lower resolution.

Landsat satellites, Indian remote sensing (IRS) satellites, IKONOS, SPOT satellites, AQUA and TERRA of NASA and INSAT satellite series are a few examples.

<u>Answer 4</u>

Ideal Remote Sensing System

The basic components of an ideal remote sensing system are as follows :

i. <u>A Uniform Energy Source</u> which provides energy over all wavelengths, at a constant, known, high level of output

ii. <u>A Non-interfering Atmosphere</u> which will not modify either the energy transmitted from the source or emitted (or reflected) from the object in any manner.

iii. <u>A Series of Unique Energy/Matter Interactions at the Earth's Surface</u> which generate reflected and/or emitted signals that are selective with respect to wavelength and also unique to each object or earth surface feature type.

iv. <u>A Super Sensor</u> which is highly sensitive to all wavelengths. A super sensor would be simple, reliable, accurate, economical, and requires no power or space. This sensor yields data on the absolute brightness (or radiance) from a scene as a function of wavelength.

v. <u>A Real-Time Data Handling System</u> which generates the instance radiance versus wavelength response and processes into an interpretable format in real time. The data derived is unique to a particular terrain and hence provide insight into its physical-chemical-biological state.

vi. <u>Multiple Data Users</u> having knowledge in their respective disciplines and also in remote sensing data acquisition and analysis techniques. The information collected will be available to them faster and at less expense. This information will aid the users in various decision making processes and also further in implementing these decisions.

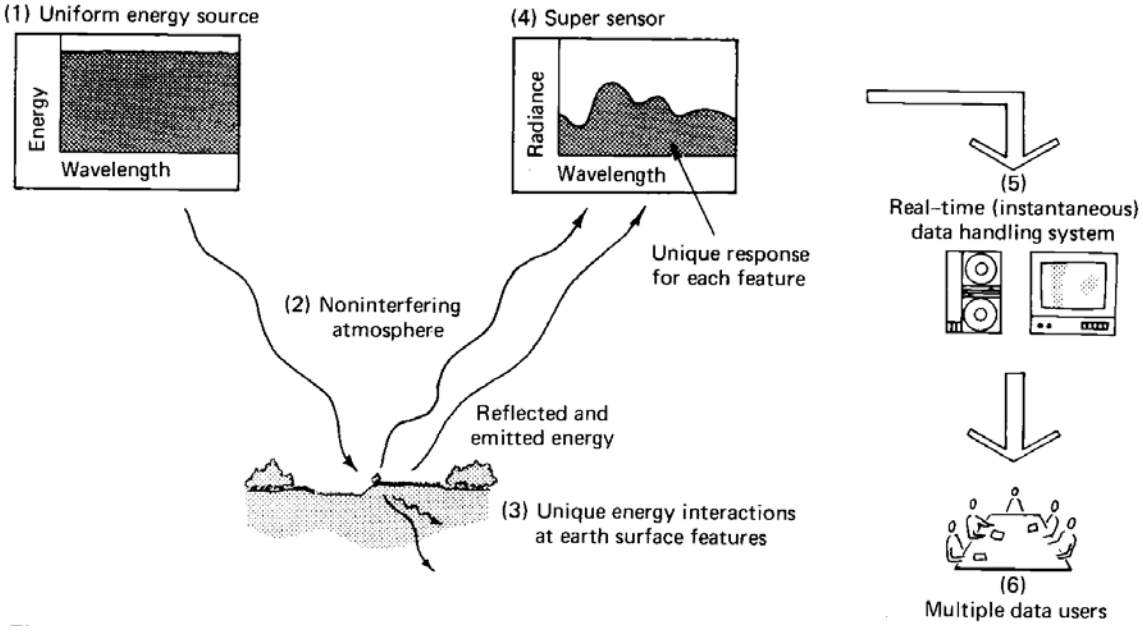

Fig. Ideal remote sensing system with Components

<u>Answer 5</u>

Advantages and Disadvantages of Remote Sensing

Advantages of remote sensing are:

a) Provides data of large areas
b) Provides data of very remote and inaccessible regions
c) Able to obtain imagery of any area over a continuous period of time through which the any anthropogenic or natural changes in the landscape can be analyzed
d) Relatively inexpensive when compared to employing a team of surveyors
e) Easy and rapid collection of data
f) Rapid production of maps for interpretation

Disadvantages of remote sensing are:

a) The interpretation of imagery requires a certain skill level
b) Needs cross verification with ground (field) survey data
c) Data from multiple sources may create confusion
d) Objects can be misclassified or confused
e) Distortions may occur in an image due to the relative motion of sensor and source

Answer 6

Diff. between terrestrial photogrammetry & aerial photogrammetry are as follows

	Terrestrial	Ariel
Platform for photography-	ground-borne	air-borne
Coverage area of photo	less	more
camera axis	horizontal	vertical
resolution	very good	good but relatively coarse
making DEM	difficult	easy
instruments	photo-theodolite etc.	camera mounted on aircraft

Answer 7

Geostationary satellites operate at a height of approximately 36,000 km above the earth.

Answer 8

Photographs are obtained by a camera system on a film by recording electromagnetic radiation within the ultra violet to photographic infra-red range of the spectrum. Images can be acquired digitally by scanner systems in the visible and photographic infrared (similar to photographs) but also in the thermal and microwave parts of the electromagnetic spectrum.

Answer 9

Using the formula given below and rearranging gives :
$\lambda = c / f$
$=3x10^8 / 5x10^{10} = 0.6$ cm
Electromagnetic radiation with a wavelength of 0.6 cm is within the microwave part of the electromagnetic spectrum.

Answer 10

The color or response of a water body is determined by reflectance and scattering from with in the body itself. Water absorbs virtually 100% of infrared radiation; none is therefore available for reflection and scattering, resulting in a black signature. The shorter blue/green wavelengths penetrate clear water the farthest and are thus available for reflection and scattering.

Answer 11

Selective scattering is wavelength dependent (and inversely proportional to wavelength) whilst non-selective scattering affects electromagnetic radiation of all wavelengths equally. The two forms of selective scattering are Rayleigh and Mie scattering. Rayleigh scattering is inversely proportional to the fourth power of wavelength while Mie scattering is inversely proportional to wavelength

Answer 12

A false color image is one in which observed colors are different from the colors of the scene as observed by the human visual system. It is produced by projecting and co-registering three images obtained in separate wave bands by colors which correspond to other wave bands. A standard false color image is produced by projecting and co registering an image obtained with in the green range in blue light, an image obtained within the red range in green light ad an image obtained within the infrared in red light.