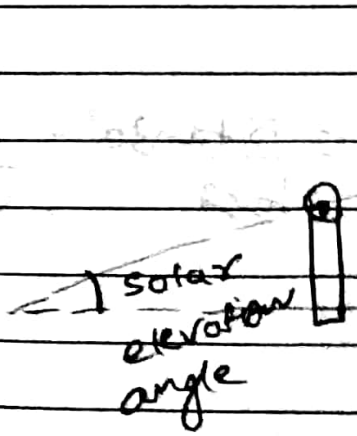
→ size (Relative size)
→ shadows – shape & height
→ Tone/color
→ Texture
→ pattern
→ site
→ association

} fundamental Recognition Elements

Cities Identification → Dots in Vegetation.
Relative size → of dots (Bigger city vs smaller city)

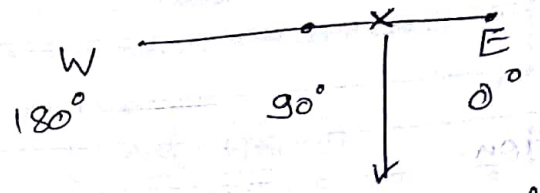
Pear faults – present in foothills of Himalayas
↓
allowed Ganga, Jamuna to come to mainland.

Shadows → tells us height



Solar elevation angle + zenith angle = 90°

Solar azimuth angle →

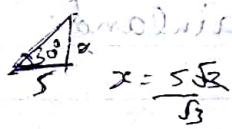


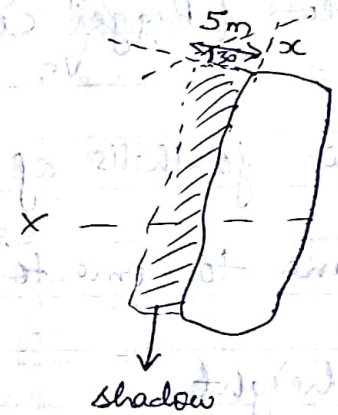
Position of sun when solar elevation ∠le is 40°

Color / tone

→ Infrared channel (algae bloom) is used in vegetation.

$\frac{x}{5} = \tan 30°$





azimuth of Sun = 90°

Elevation angle = 30°

elevation = $\frac{5 \tan 30°}{\tan 3} = \frac{5}{\sqrt{3}}$

दिनांक : .....

→ Texture (Gray Scale Images)

color tone same

↓ Smoother texture → Indicates water Body

↓ Coarser texture (Rougher) → Indicates city.

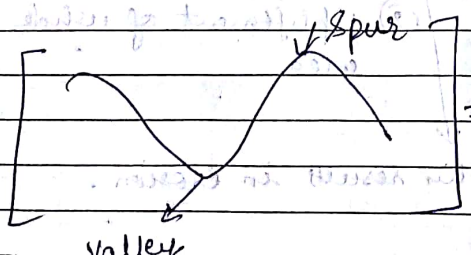
→ site & associations

Cooling towers shown → correlating to some power plant.

Dykes (Can only be associated when we have Singhbhum granite as the country rock)

Topographic maps → Valley.

In google earth Image → we see structures (i.e fold)



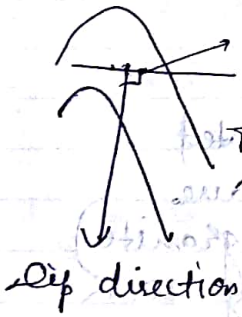
⇒ but the structure is a fold.

शिक्षक के हस्ताक्षर : .....

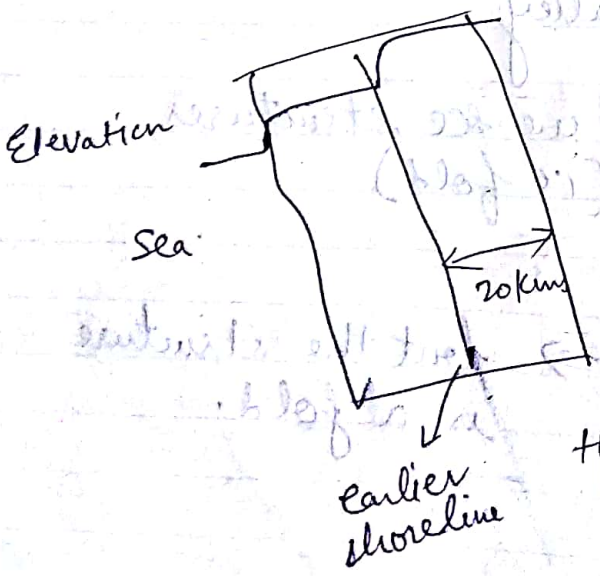
Structures are usually formed very older (paleocene, Miocene etc.)
↳ ~~geomorphology~~
geological features

Valley → thousands of year old
↳ geomorphological features

Dip / strike from Google earth



Upliftment and terraces



① Relative sea level fall
② Upliftment of whole area

this results in erosion.

दिनांक : .....

Permafrost depressions → Glaciated regions ground water is also frozen. When in warming phase, those are de-glaciated, the space occupied by glaciated Ice is released causing depressions.

It can be understood by Google earth.

30/7/18

Books – written in course Syllabus

Remote sensing → Obtaining information about an object or feature without physically coming in contact.

In this course, we will deal with remote sensing through EM energy sensors only.

Remote Sensing

Passive system (source of energy is sun)

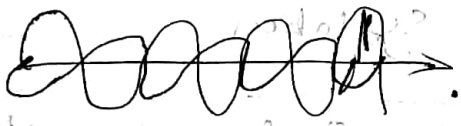
active system (putting extra source of energy)

Mapping is done in terms of Digital numbers.

शिक्षक के हस्ताक्षर : .....

Ideal Remote Sensing system

1. uniform energy source [EM radiations]
2. Non-interfering atmosphere
3. Unique energy interactions at earth surface features.
4. Super sensor
5. Real-time (Instantaneous) data handling system
6. Multiple Data users.



$C = \lambda f$

↓

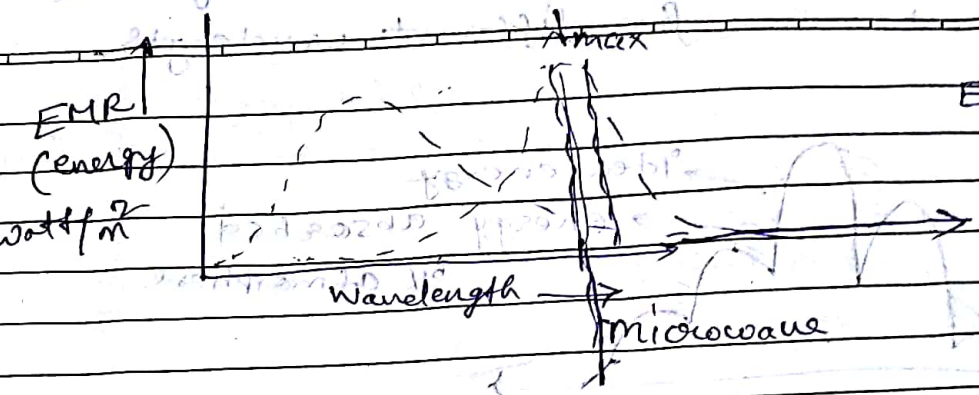
velocity equals velocity of light

γ X UV Visible Infrared Microwave Radiowave

0.4 (μm) — 0.7 micron (μm)

wavelet

दिनांक : .....

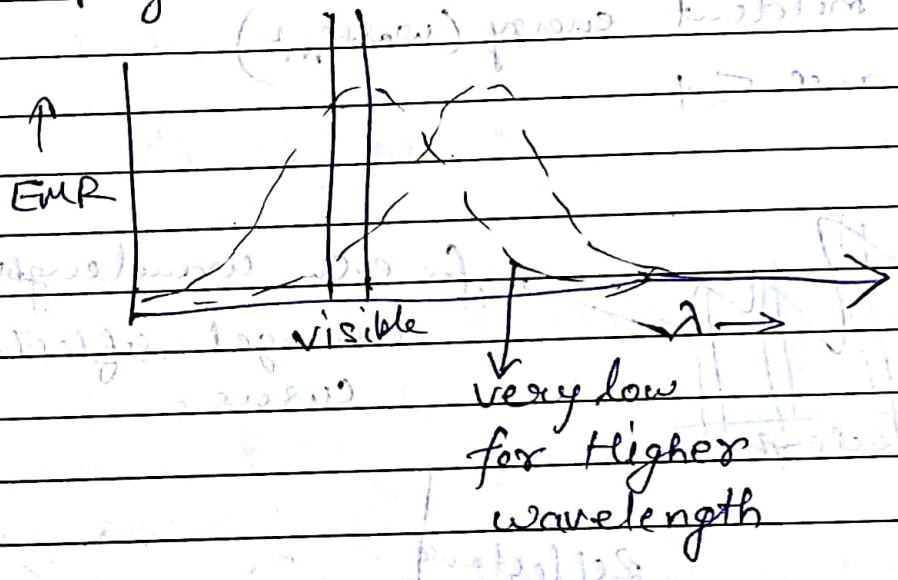


Wien's Displacement law → $\lambda_{max} = \frac{A\ (constant)}{T}$

High Temp. → λ_{max} low

Dead star → λ_{max} near to the Microwave region

Temp. of sun → 3000K

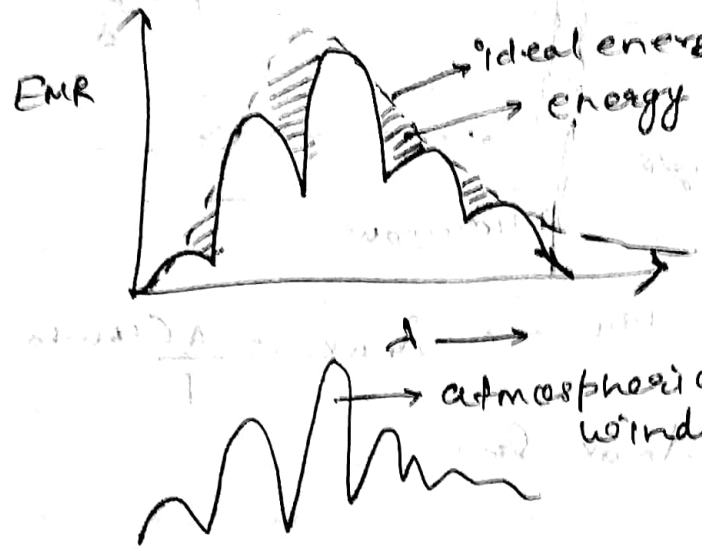


ENERGY SPECTRUM

for Dead star, this peak shifts close to Microwave region.

शिक्षक के हस्ताक्षर : .....

Super sensor → No super sensor actually exist.
→ Different sensors for different wavelength.

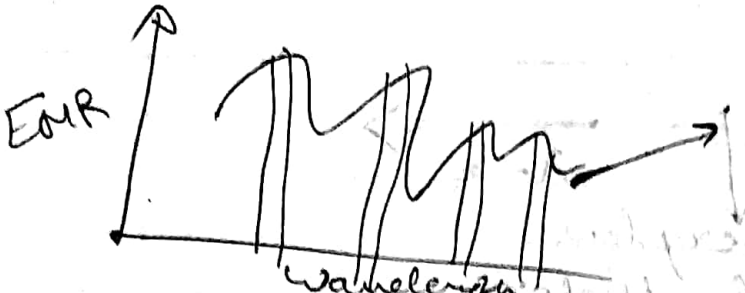


(Designing a sensor)

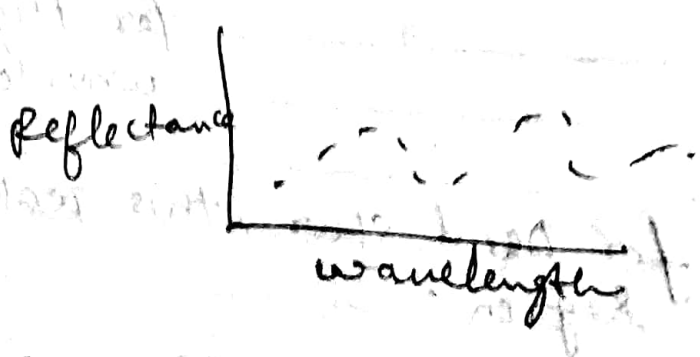
→ How to get Reflectance value ?

$$\text{Reflectance} = \frac{\text{Reflected energy } (w/m^2)}{\text{Incident energy } (watt/m^2)}$$

$0 < \text{Reflectance} < 1$



→ for each wavelength, we get reflectance curve.



→ sensitivity & Non-uniform source of reflection.

दिनांक : .....

Source energy with wavelength
Sensor Receiving with wavelength energy
⇓
Ratio gives us Reflectance variation with wavelength.

spectrometer – collects different energy for different wavelength.
↓
can collect incident energy from source
& can collect reflected energy from the rock sample.

→ Reflectance curve is not problematic because we are taking ratio.

O_2, CO_2, H_2O, N_2, O_2 ⟶ Gases responsible for absorption

⟶ Sensors should be made such that they lie in atmospheric window not in absorption Range otherwise no Image is recorded.

two concepts → atmospheric absorption
→ atmospheric window

⟶ Sun is emitting not much radiations in Microwave region because of $\lambda max = \frac{A}{T(3000K)}$

so putting sensors in Microwave region for sun is not of that much use.

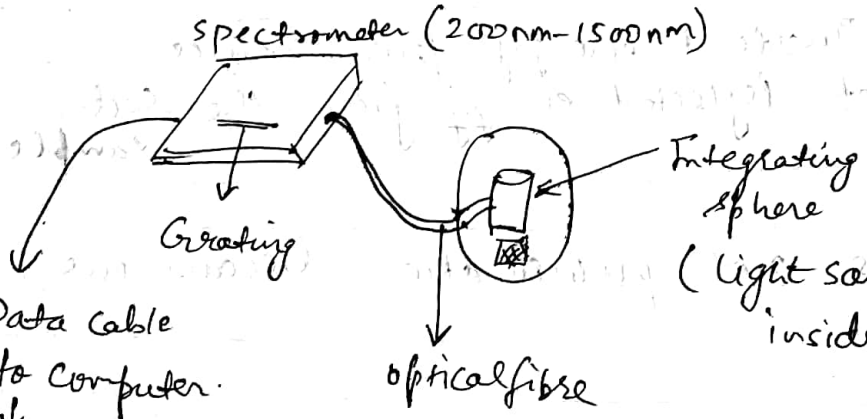
शिक्षक के हस्ताक्षर : .....

31/7/18

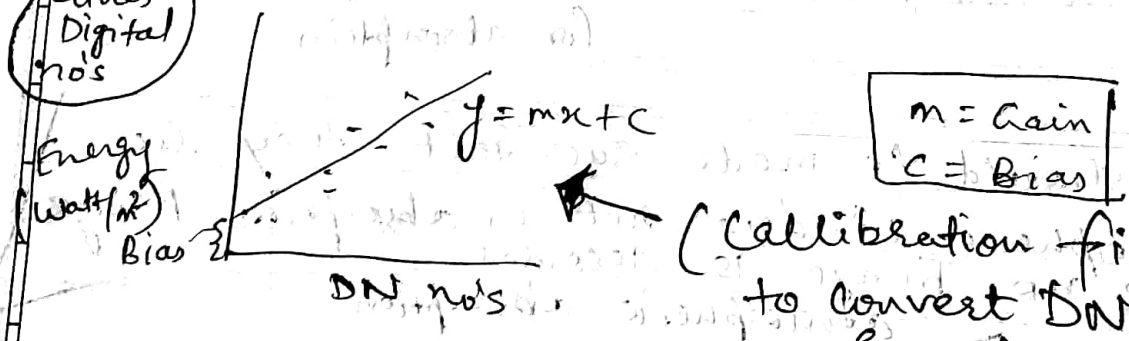
CO_2, H_2O (water vapour), O_3 concentration around the Globe can be mapped using Remote Sensing technique.

By absorption curve → spatial variation in the conc^n of Gas

Optical fibre experiment



Gives Digital no's



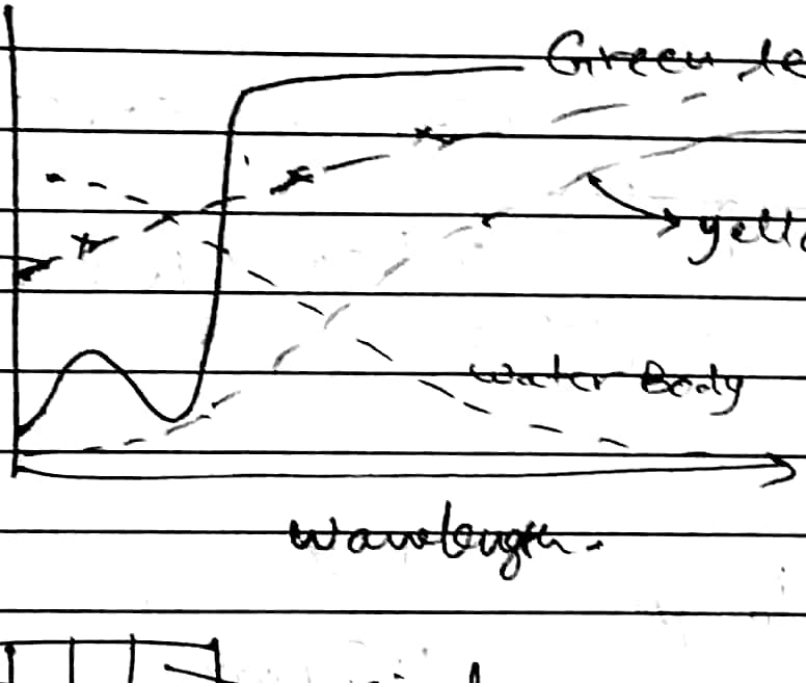
m = Gain
C = Bias

(Calibration file) to convert DN values to Energy

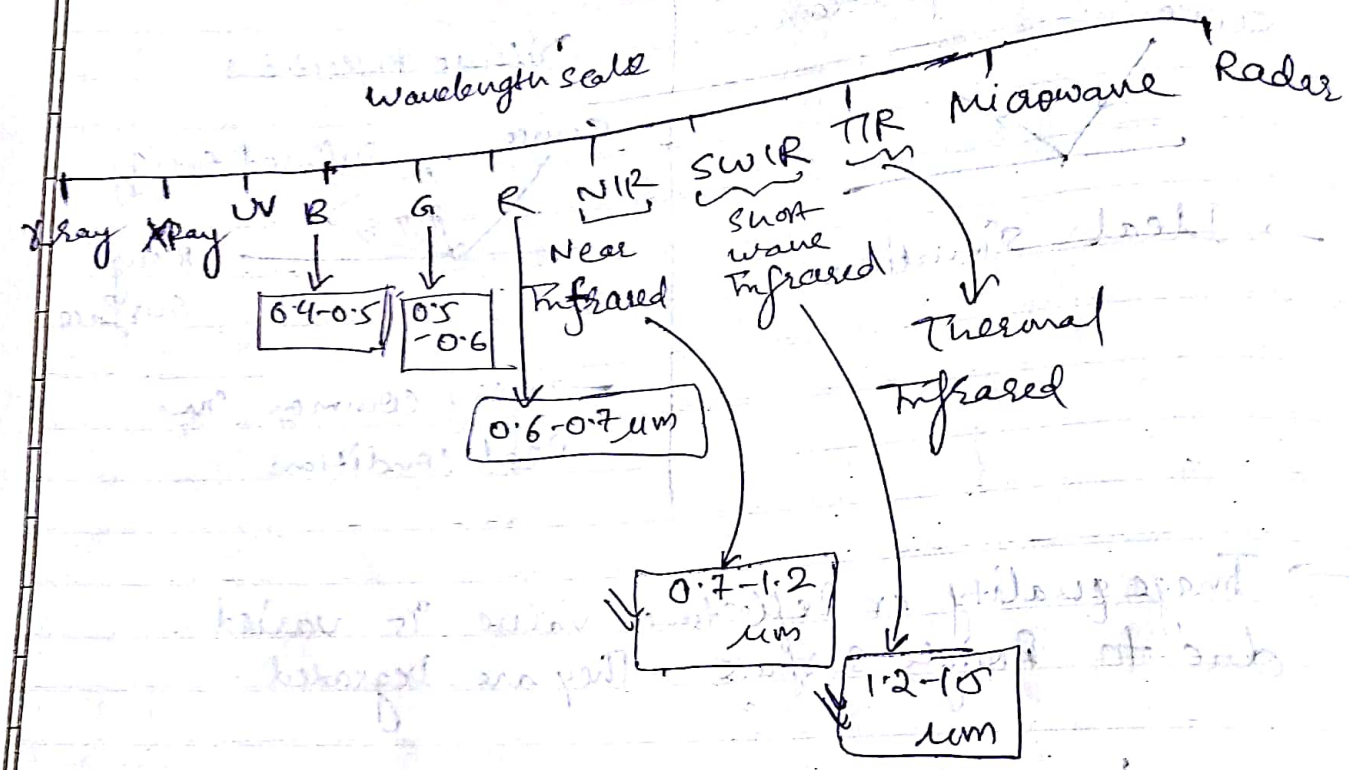
The Digital no's is fitted to a line to given Gain & bias - Basically, these Digital no. are converted to Energy (watt/m²).

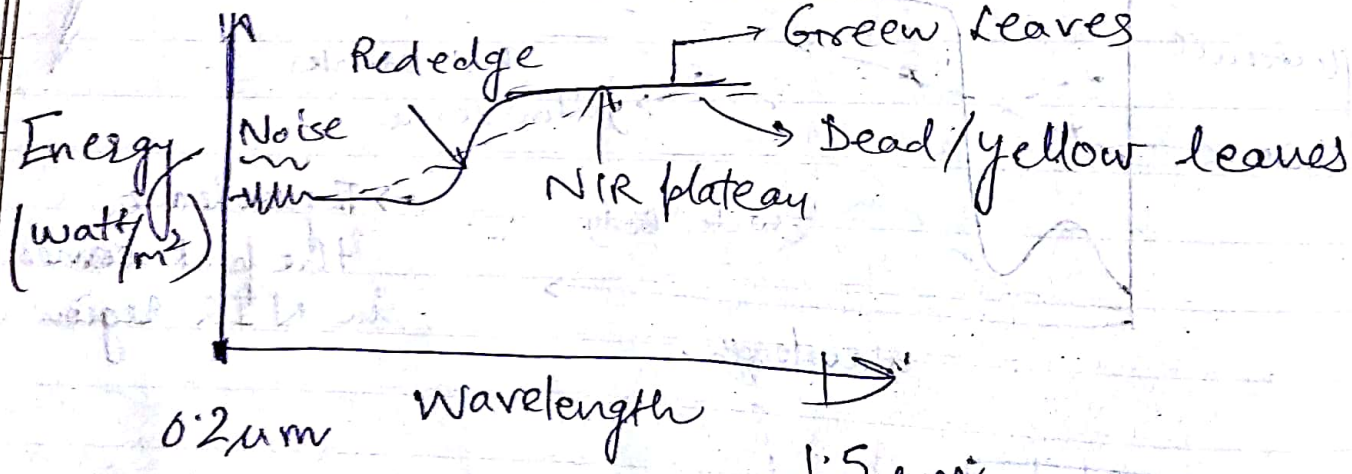
→ very common in Real conditions

quality or Reflectance value is varied to Rough surface. They are Degraded.

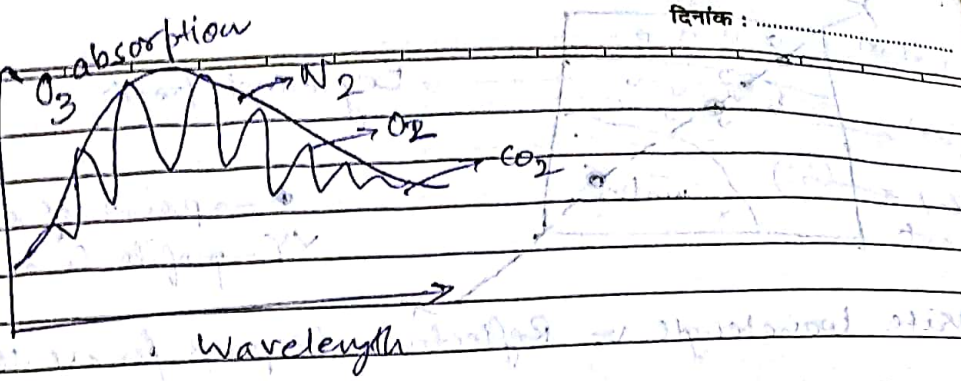


→ In green leave, the peak comes in NIR region





दिनांक : .....



Now imagine we have spectrometer moving all around the globe.

Rural area → DN = 20

City area → DN = 5 (Aerosol amount is much higher as compared to rural area)

→ Mapped CO_2, CH_4, SO_2, O_2 conc^n around Globe by Reflectance curve. (Atmosphere mapping)

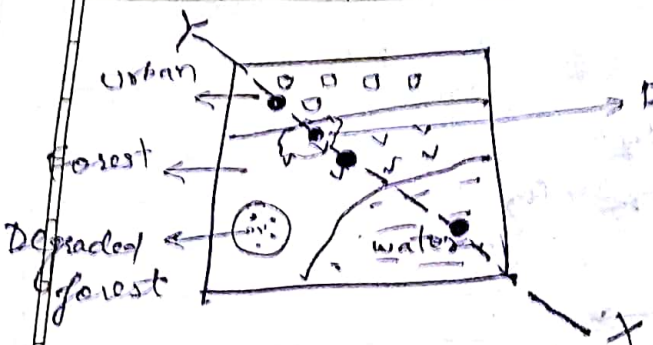
→ Percent of Degradation of forest (pockets of Blank area amidst highly vegetated area)

→ Mineral Exploration (Alteration Zone)

→ all sorts of mapping even in area which is beyond reach of Humans.

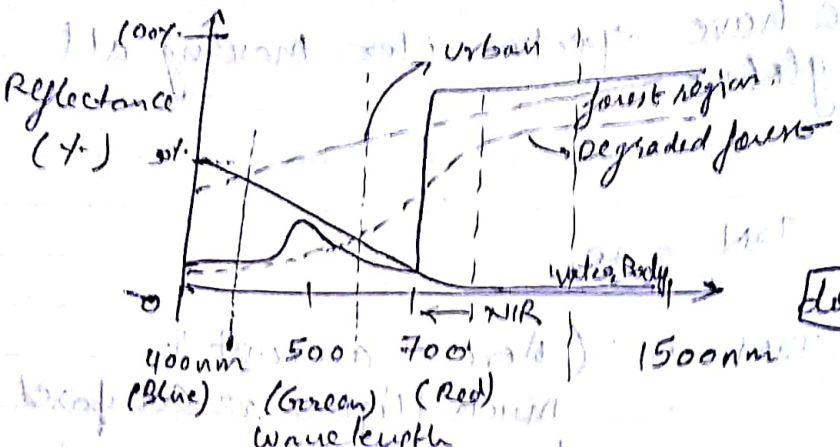
शिक्षक के हस्ताक्षर : .....

Problem →



● → point of observation.
XY → profile line

Write wavelength vs Reflectance response for all three zones.



Green color → photosynthetic process absorb more / max. light in visible region but this process take place in NIR, hence more reflection and a plateau

water Body → IR band will have absorption.

Green colored forest → NIR plateau (characteristic)

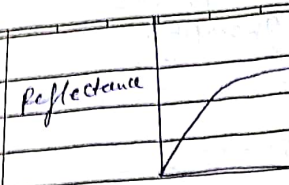
Urban → mostly uniform reflectance curve.

for satellite, we define → **Bands**

400 - 500 — Blue Band
500 - 600 — ~~Red Band~~ Green Band
600 - 700 — Red Band
700 - 1500 — NIR Band

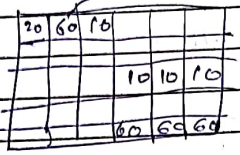
In this question, we have 4 bands

दिनांक : .....



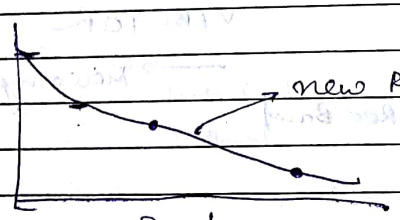
→ Designing a sensor — should be very simple
— we contain (as above) only 4 points from (Reflectance Vs wavelength) plot.

Gray scale Image



(Division in pixels or array of numbers)

No's are sensitive to Blue Color Band sensor we will define green Band sensor, Red Band sensor and NIR band sensor.

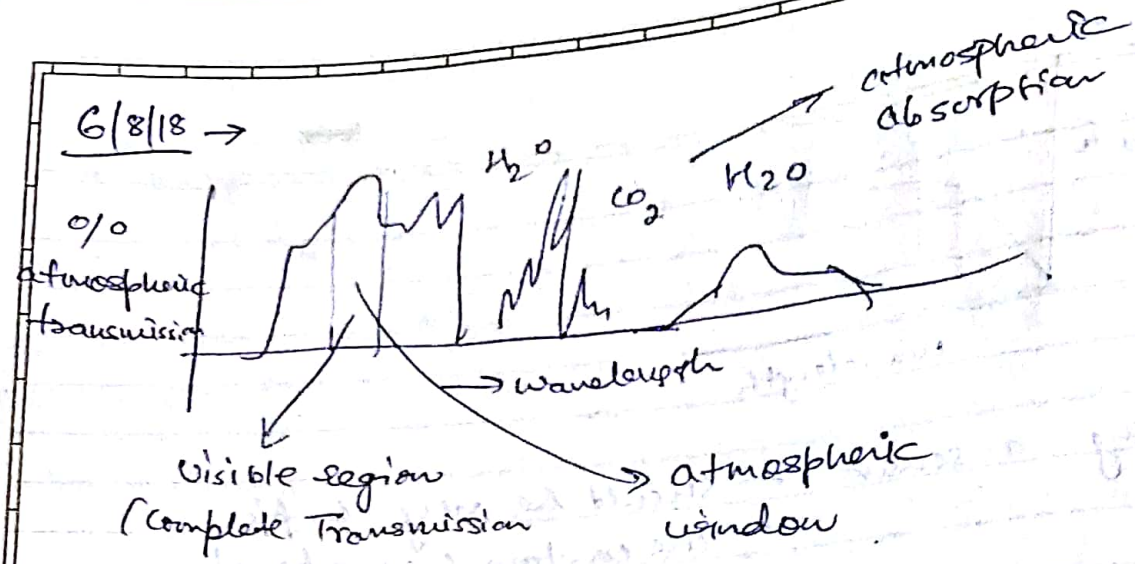


(acquisition of Image from satellites)

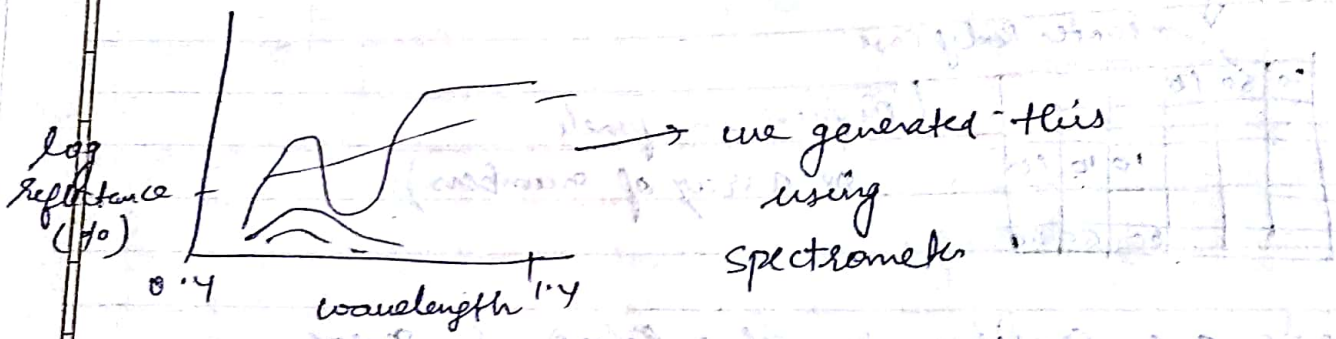
→ gradually we are trying to reach the spectrum when spectrum sensor is in our hand.

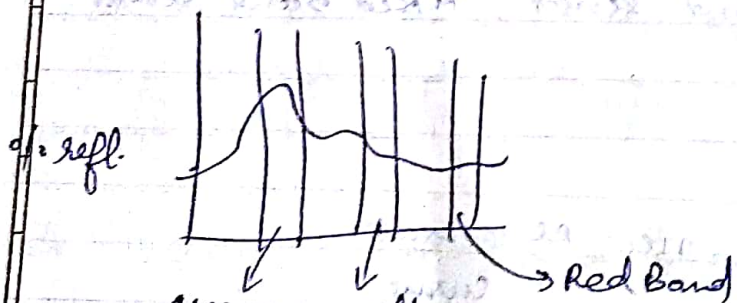
शिक्षक के हस्ताक्षर : .....

6/8/18 →



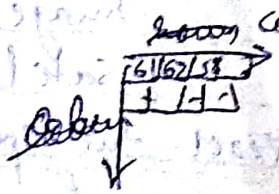
Designing a sensor → absorption spectra must be known





VIBGYOR → Increasing λ

NIR band



→ array ~~no of~~ of mol's.

दिनांक : .....

Dark colour → black color = 0
Brightest colour → whitest one = 255

In NIR band — all absorption takes place
low value → Red color

Grayscale Image → Temperature / Density slicing (trying to put some color scale)
for a particular Band (Here let's say NIR band)

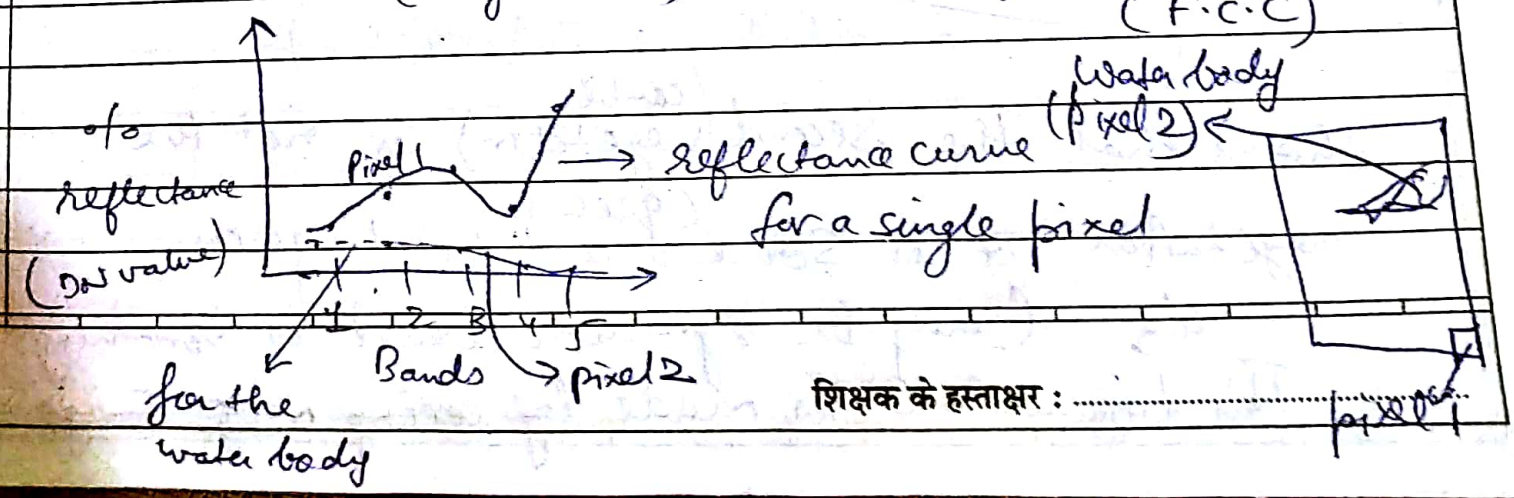
for the same → we can display it in different bands based on their reflectance.

Gray scale → will allow us to see different objects within the same area.

Water is completely absorbing the NIR band and that is why it is completely black.

Monochrome Image
(Single Band)

false color composite
(F.C.C)



शिक्षक के हस्ताक्षर : .....

RGB – primary color composite (True color composite)
any other composition we made are False color composite

R – G – B
3 2 1 (band no.)
2 3 1 is also a false color composite
1 2 3 —"— —"—

only single possibility for a true color composite

bands and band composite
(Single Band) (combining various bands)

Can be vegetation (green) + Can be vegetation (green) → True color Composite

Red + black → NIR

shows that the second (Can be vegetation) is not the vegetation. It is some artificial green (green) color (may be synthetic carpet or something)
This differentiation is made by seeing NIR Image

दिनांक : .....

Digital Number

→ generic term for pixel values is DN
→ It used to describe pixel values that have not ~~been~~ yet been calibrated into physically meaningful units.

Radiance :- amount of radiation coming out from an area.

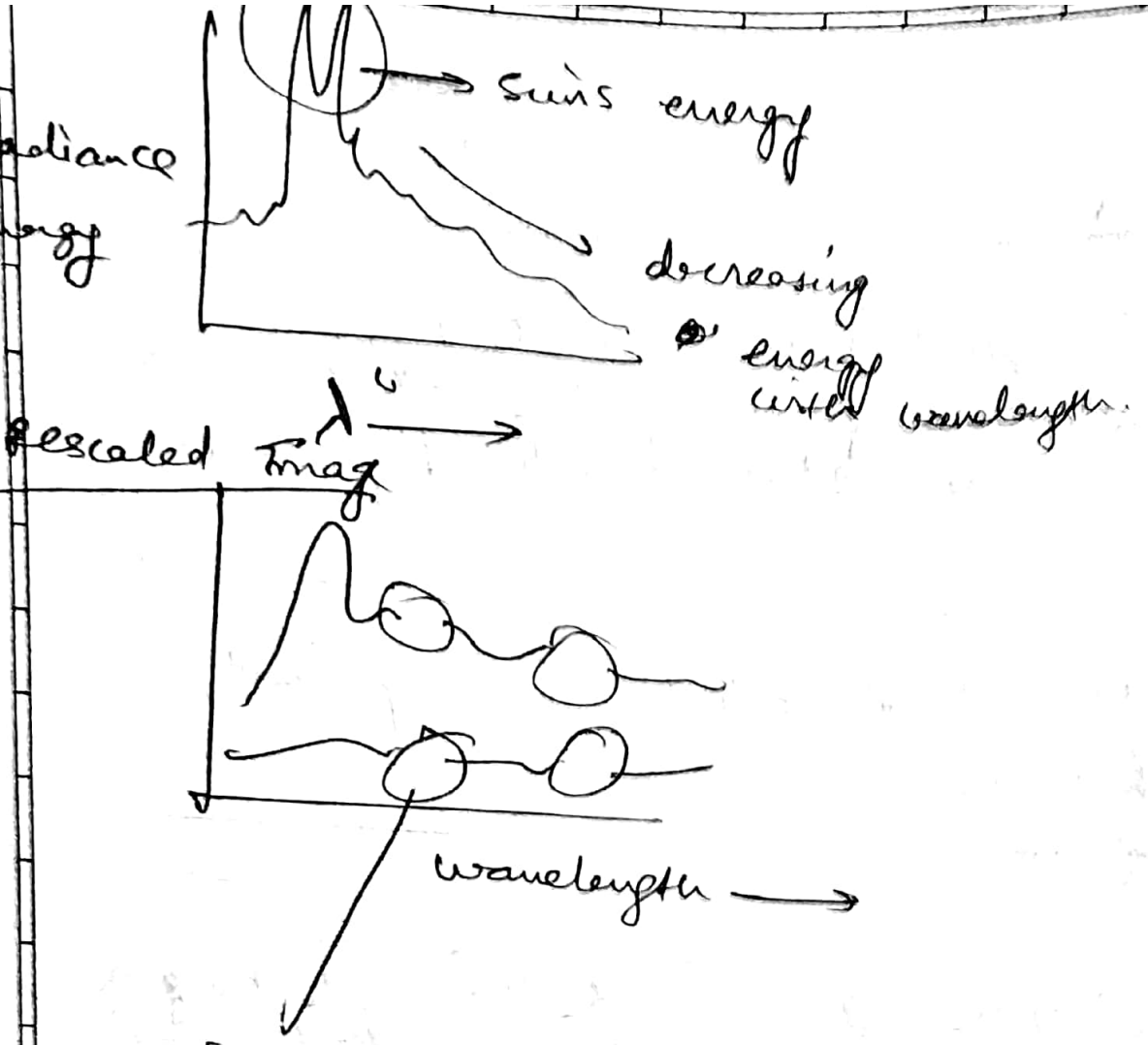
Gain & offset

Reflectance :- proportion of the radiation striking a surface to the radiation reflected off of it.

Reflectance = Reflected radiance Energy / Incident Energy / Radiations

It is not easy or Impossible to allot DN number to sun's energy which is Incident energy
so to calculate Incident energy, modeling of atmosphere is necessary.

शिक्षक के हस्ताक्षर : .....

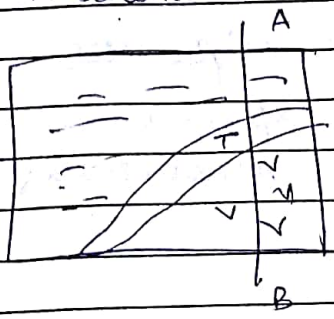


missing part indicates (I) atmospheric absorption (N_2, O_2, O_3, CO_2 (D) we do not have sufficient information about reflected energy (H_2O)

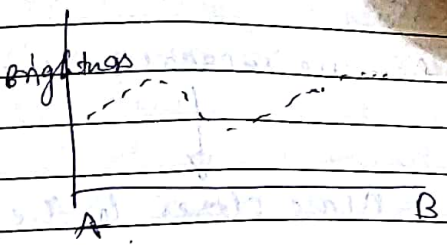
दिनांक : .....

7/8/18 →

Resolution →



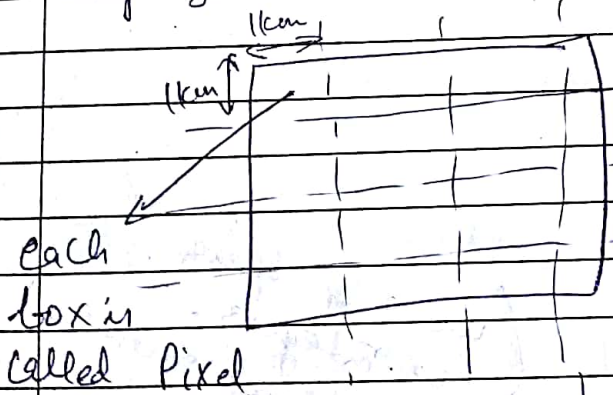
Real world analogue data



AB profile

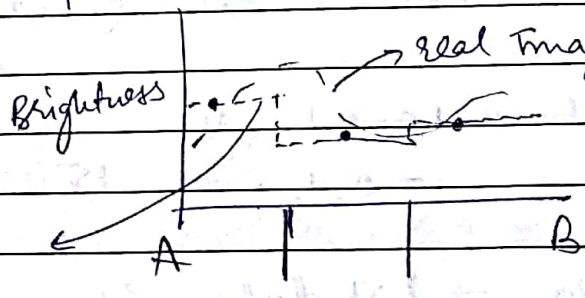
1. Quantization
2. Digitization

Digitization is linked with spatial resolution



Real world Image dividing into 1km - 1km interval

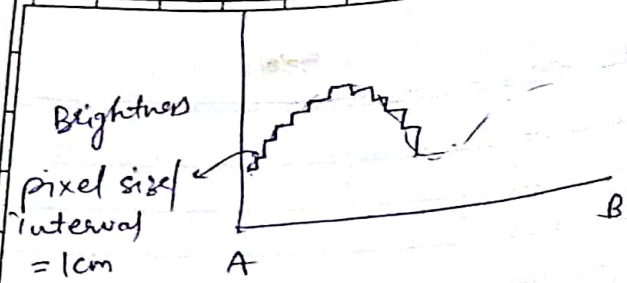
each box is called Pixel



profile

When ~~the~~ pixels have been defined, it will be constant value in each box.

शिक्षक के हस्ताक्षर : .....



When we increase our Resolution

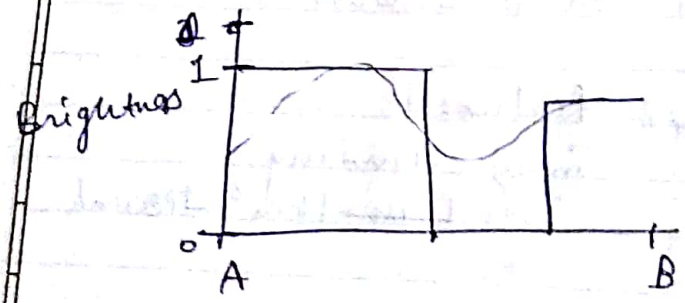
↓

more closer to the Reality

Higher the spatial resolutions.

Digitization done in the lower mode of resolution as in case of Landsat which has 30 m of resolution.

QUANTIZATION →



2^1 = 1 bit data = 2 data sets = 0, 1

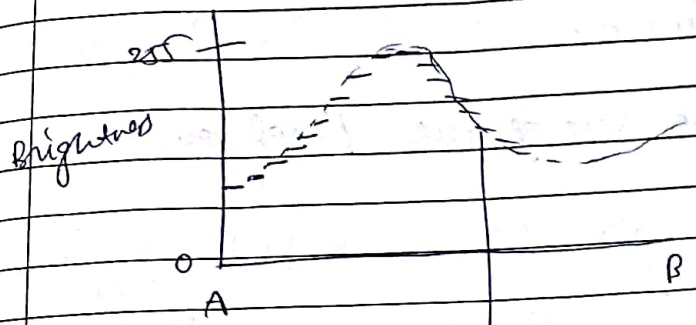
(we only have the Integers, no float numbers)

2^4 = 4 bit data = 16 data sets
= 0, 1, - - - -, 15

2^8 = 8 bit data = 256 data sets
= 0, 1, - - - -, 255

दिनांक : .....

→ If we ↑ bit no. → we have more & more of values



Radiometric Resolution of a sensor is measure of how many grey levels are measured betⁿ pure black (no reflectance)

Increasing the Bit no. [Increasing different shades of Gray]

↓

means Increasing the Quantization

↓

more close to the original / Real Image curve

↓

This is Radiometric ~~Quantization~~ Resolution

↓

Increasing Resolution / Image Quality

→ In most of the cases, Quantization level is 8-10 bit

30m — Landsat

10 cm — Google earth

1km — MODIS Satellite program

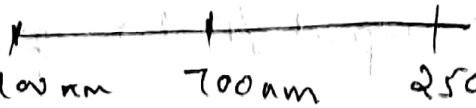
शिक्षक के हस्ताक्षर : .....

Spatial Resolution is a measure of the area or size of the smallest dimension on earth's surface over which an independent measurement can be made by the sensor.

→ It is expressed by the size of the pixel on the ground in meters.

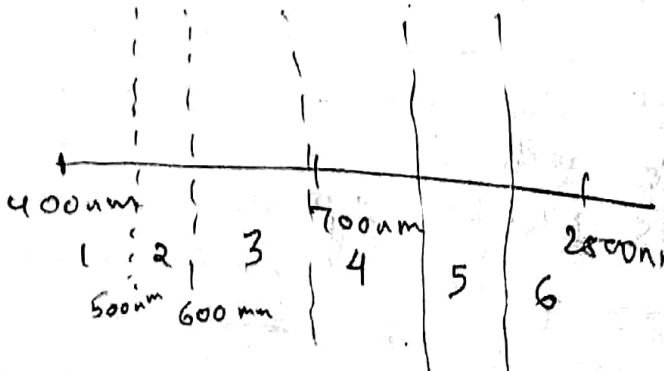
Spatial res. → Pixel size
Radiometric res. → How many
Temporal res. →

Spectral Resolution →
How many bands.



0.4 μm 0.7 μm 2.5 μm (Micron)

VNIR range
Visible + Near Infrared Range



Landsat

We can increase the no. of bands as per our Requirement

दिनांक : .....

MODIS

Landsat (Lower Resolution)

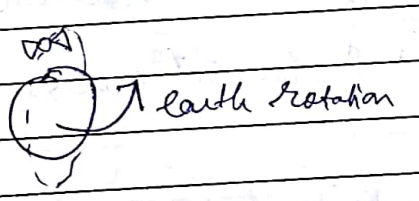
Temporal Resolution → Revisit time

(1) Geostationary - particular earth's surface monitoring

(2) Polar - Continuous monitoring of earth surface.
(covers full earth)

Geostationary

Polar/sub polar



Sun-synchronous

Rotating the Satellite path itself
(Revisit the same time in a same area)

शिक्षक के हस्ताक्षर : .....

Laptop exercise →

Excel → format → Row height = 5
Column Ht = 3

Q-1 for the give Image, Identify 3 features

Q-2 Determine width of bridges in terms of pixel counts. = 1 pixel

Q-3 If width of bridge in actual is 1m, what is Spatial resolution of Image. = 1/10 m

Q-4 Determine radiometric and spectral resolution.

Q-5 Identify darkest and brightest spots from different bands

Q-6 If the given gain for NIR, Red, green respectively 0.05, 0.1, 0.3 and bias for all is 0, convert image into radiance Image.

Q-7 Draw reflectance curves for identified 3 features

1. Building, water, bridge, vegetation, cemented structures.
2. 10 pixel
3. 1/10 m
4. NIR = 244 to 8 (Radiometric)
   Red = 255 to 0
   G = 255 to 5
   B =

Radiometric

Spectral Resolution = 3 Bands

दिनांक : .....

(5) ~~Darkest~~ → water
Brightest → Bridge.

(6) Gain for NIR, Red, Green = 0.05, 0.1, 0.3 and Bias for all = 0, Convert 3 images into 3 Radiance Image

$y = m x + C$

x → DN value
m → gain
C → bias

$y = 0.05 x$ → for NIR
$y = 0.01 x$ → Red
$y = 0.3 x$ → Green.

Radiance

(7) Drawing reflectance curve for identified 3 features = Radiance value are reflected values / Incident

Reflectance = Reflected Radiance / Incident Radiance (brightest object)

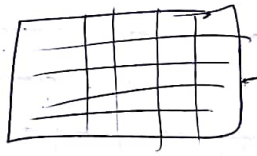
But there is always a Dark Noise.
comes from Darkest Object → we won't get a perfect zero here. due to some Noise.

शिक्षक के हस्ताक्षर : .....

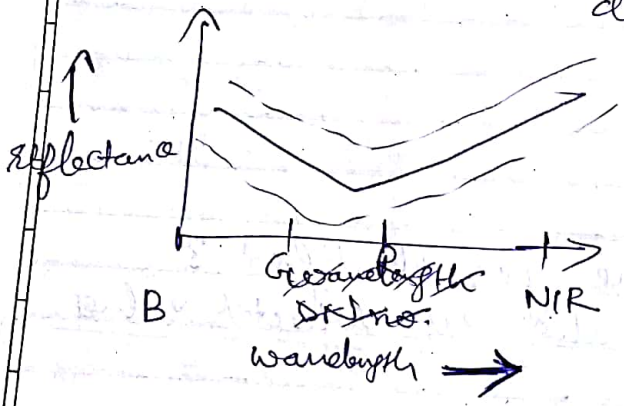
Reflectance = (Reflected radiance − Darkest object (Radiance value)) / (Incident radiance for brightest object − Darkest object (Radiance value))

↓

but where to find ?

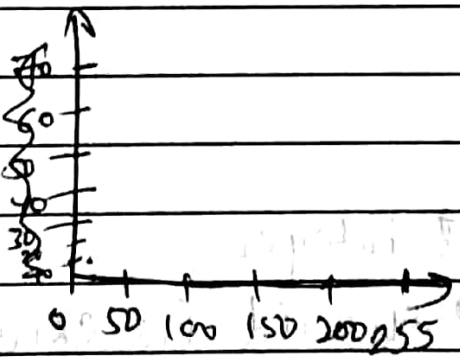


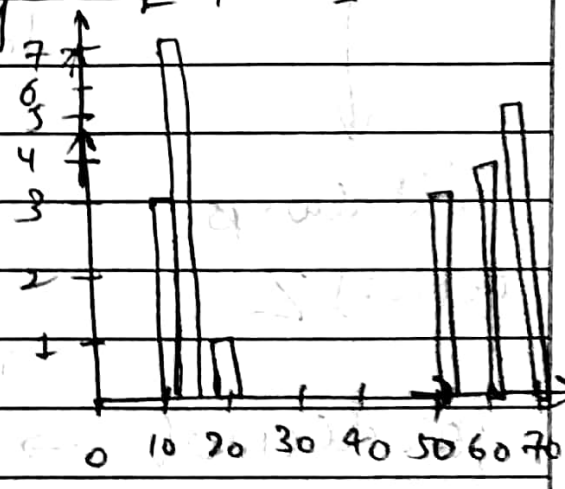
→ average the value & measure standard deviation.

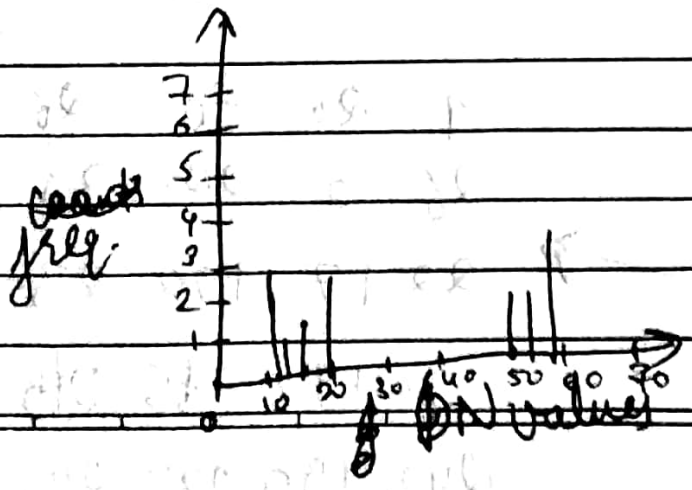


8-bit Image → DN value range = [0, 255]

Radiometric Resolution





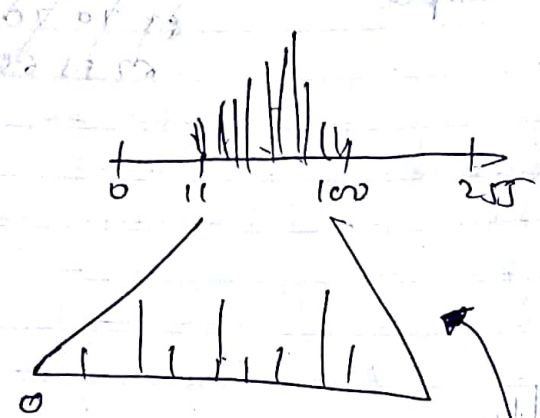


Histogram

शिक्षक के हस्ताक्षर : .....

→ general problem with satellite Image.
They generally do not occupy ~~all~~ the complete dynamic range of 0-255. The DN values are concentrated within a shorter range.

Not proper contrast → Individual object is not separated from each other. Hence after linear stretching proper contrast is obtained



convert 11 to 0
and 100 to 255

This process of redefining the image is linearly stretched Image

$$\text{New DN} = \frac{\text{old DN} - \text{Old min}}{\text{Old Max} - \text{Old min}} \times 255$$

will always be (true) Z

for decimal → nearest Integer should be considered.

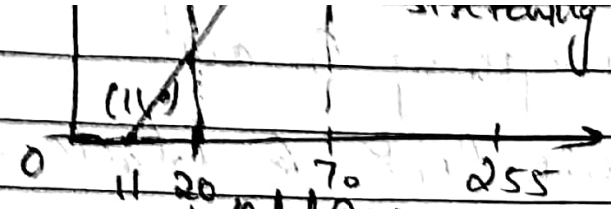
linear stretching	12	17	18	17	11
	17	11	16	20	15
	16	15	55	65	65
	11	55	70	70	67
	67	55	65	67	68

→

4	26	30	26	0
26	0	22	39	17
22	17	190	233	233
0	190	255	255	242
242	190	233	242	242

Linearly stretched Image

This is first kind of Image enhancement



4	26	30	26	0	water
26	0	22	39	17	
22	17	190	233	233	Land → has high DN value
0	190	255	255	242	
242	190	233	242	246	

Sudden increase in DN values

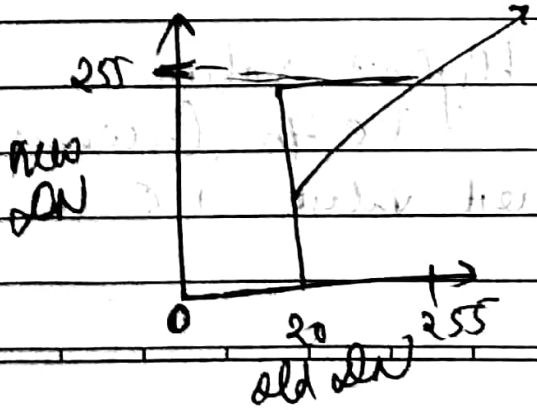
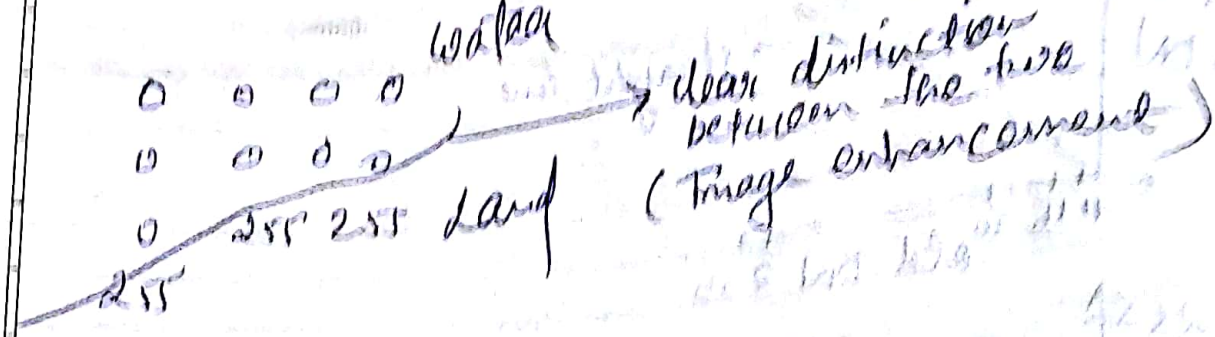


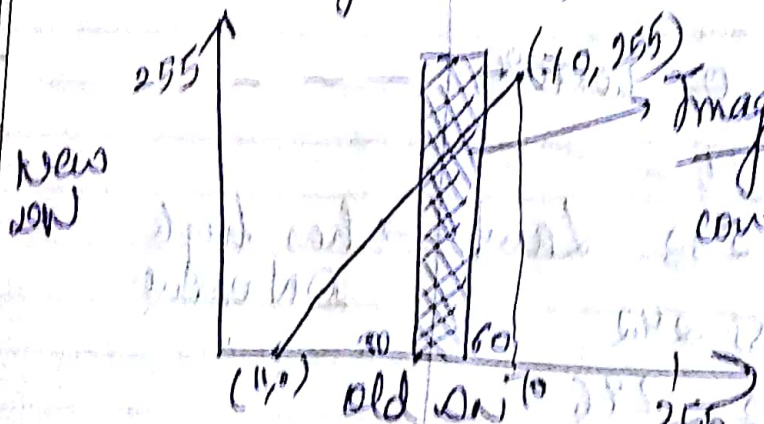
Image threshold

Black-white image (kind of image enhancement)

शिक्षक के हस्ताक्षर : .....



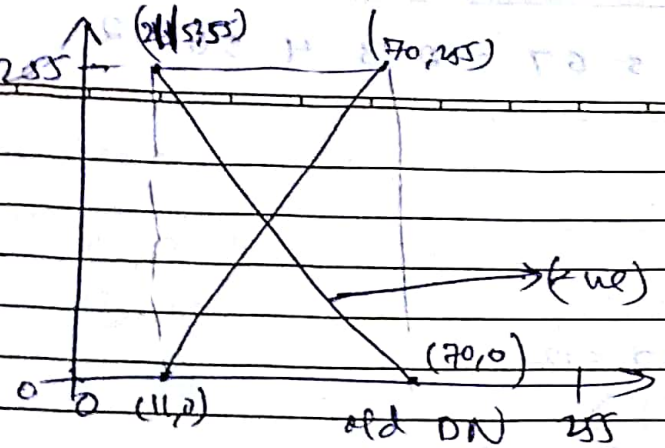
(3) we know (62.7%) is our vegetation area
~~then we can make that part~~
then we will make everything 0 and
then the vegetation will look black.
This is Image slicing



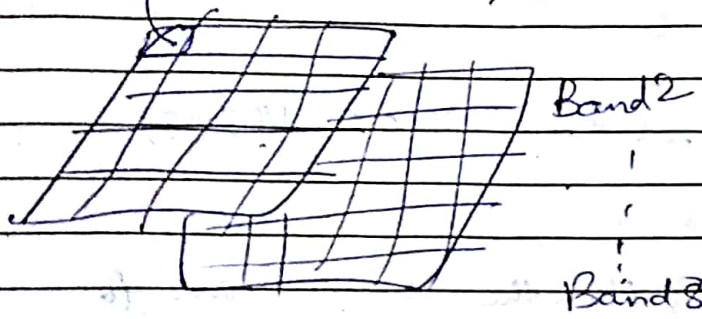
converting 50-60 into 0-255 range
[It is helpful in identifying area of vegetation or urbanized area]

(4) Negative Image → Highest value i.e 255 becomes as 0
lowest value i.e 0 becomes 255

दिनांक : .....



14/8/18 → row1, column1, band1

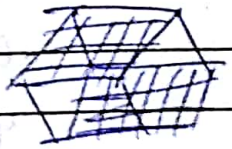


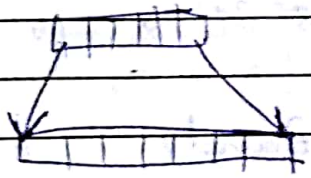
BSQ - Band Sequential
BIP
BIL
} all are different types of numbers

Sensor Designing — looks like spectrometer

Linear array arrangement

BSQ format



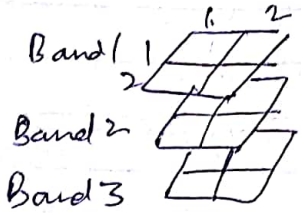


शिक्षक के हस्ताक्षर : .....

28 39 40 10 5 67 2 3 4 5 6 11 12

3-bands
2-columns
2-row

Total DN no = 3×2+2 = 12



(for a particular band, we have 4 pixel)

Data format – BIP (used in 1970's – 1980's)

Whisk broom camera

then the sensor move to adjacent pixel.

first pixel of every band is recorded together

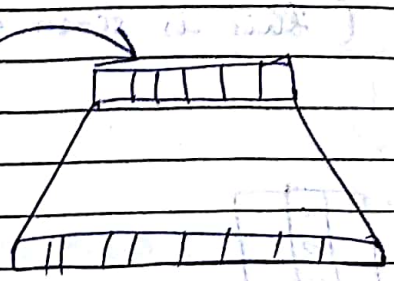
28 39 40 10 5 6 7 2 3 4 5 6 12

Band 1	Band 2	Band 3
28 10	39 5	40 6
7 5	23 6	4 12

दिनांक : .....

BIL format →

Recorded by Push broom camera



Band1		Band2		Band3	
28	39	40	10	5	6
7	23	4	5	8	12

Row wise value लेता है।

BSQ format → Band wise sequential

	Band1		Band2		Band3	
BSQ	28	39	5	6	4	5
most advanced	40	10	7	23	6	12

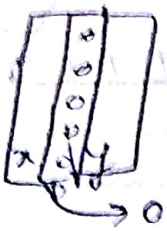
It is not necessary always 2×2 matrix will represent Band1 but it is because we have defined earlier 3 Bands, 2 rows and 2 columns

Metadata → Every data file contain Meta data / header file / auxiliary info, which gives information about how to read the array of numbers i.e Information about, columns & bands, Camera type etc...

शिक्षक के हस्ताक्षर : .....

Class exercise ⟹ :

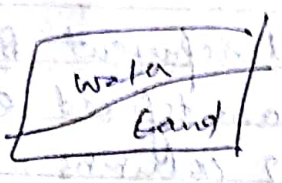
Column is scanning completely 0
(this is sensor defect) value = 0
is basically here is Noise



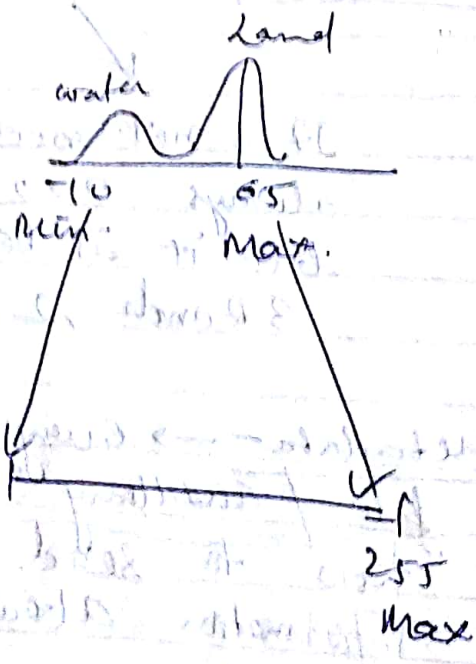
→ 0 is replaced by $\left(\frac{x+y}{2}\right)$ (from neighbouring pixel) average out.

Density slicing ⟹ use of color scale instead of a gray scale.

Initial distribution — Bimodal



Increase

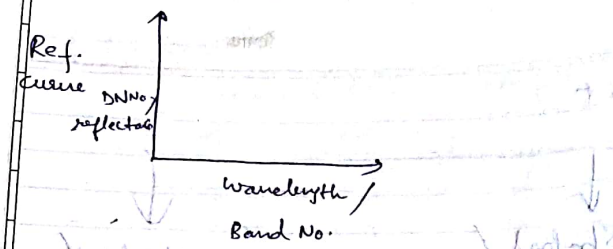


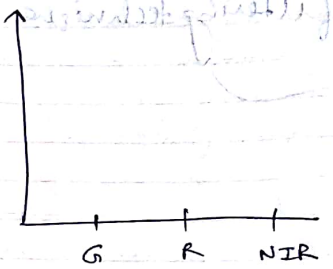
Unit 2

Georeferencing / Spheroid Datum

2018 | 18 →

Ref. excel file →





Bright object & Dark object method

① $y = mx + C$

Radiance value
(Energy Information)

$y = DN * Gain + bias$

② Max and Min from every band
In NIR, water should not have any reflectance but it is giving value as 5
It is due to atmospheric Noise etc..

$y = DN \times Gain + bias$ - Dark Noise / Dark object

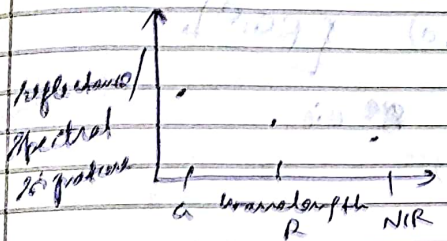
↓
amount of reflected energy

दिनांक : .....

③ The next step is to identify Incident / Downwelling energy.

Incident energy = (in Brightest object) − (Dark object)

Reflectance should vary betⁿ 0 to 1



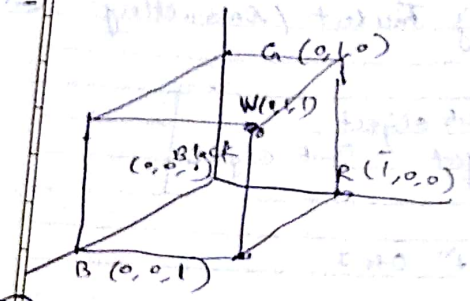
$$\text{Reflectance} = \frac{(DN \times Gain) - (Min \times G + Bias)}{(Max \times G + B) - (Min \times G + Bias)}$$

Why vegetation as a green color ?
Because the DN No. of vegetation in green band is Maximum. ☺☺

शिक्षक के हस्ताक्षर : .....

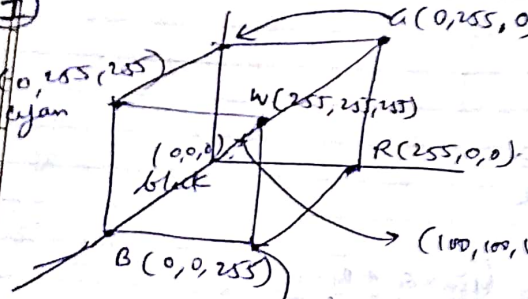
(Digitization of colors)

Colors :-



1 - Bit

(I)



RGB

8 Bit

(100,100,100) : Grey color (perfect grey line) as all values on x, y and z are equal

(255,255,0)
Magenta
[combination of Red and Blue]

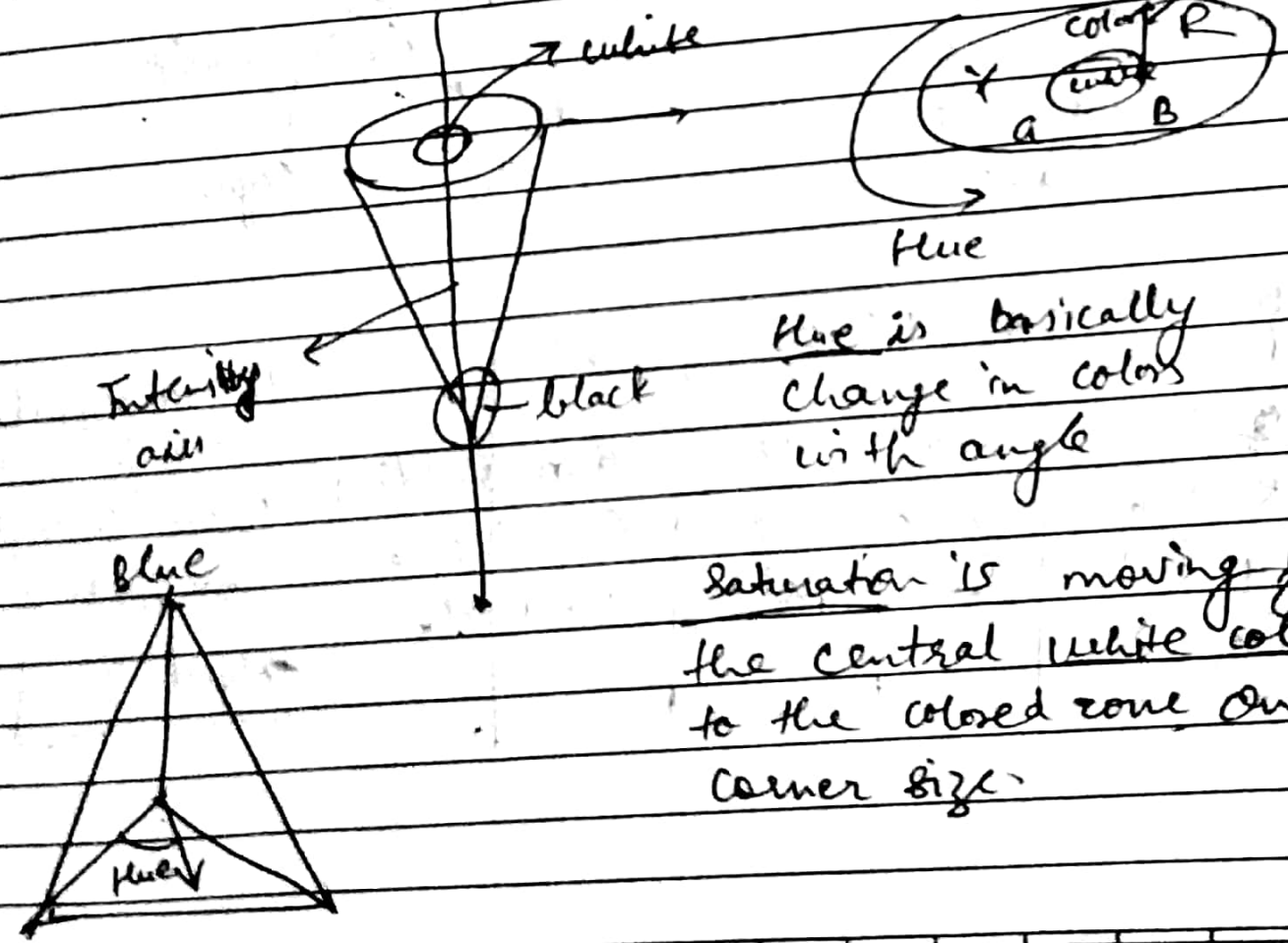
This line is called as "Grey-scale line"

Total no. of colors $= (28)^3$ [for a 8-bit data]

Projector – R, G, B

) Hue Saturation & Intensity (HSI) model →

Our human eyes are more sensitive to ~~this~~ three models shown above-



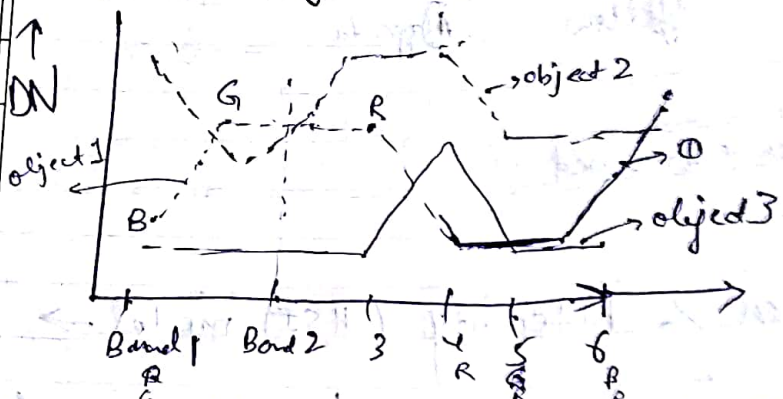
Hue is basically change in colors with angle

Saturation is moving from the central white color to the colored zone on the corner side.

शिक्षक के हस्ताक्षर : .....

21/8/18 →

Reflectance curves for following 3 objects / spectral signatures.



for object → R, G are almost same while B is less so almost it is yellow like

What will be colors of 3 objects for FCC

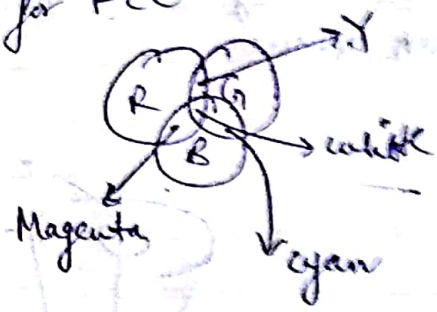
R G B

3 - 2 - 1

5 - 1 - 6

4 - 5 - 1

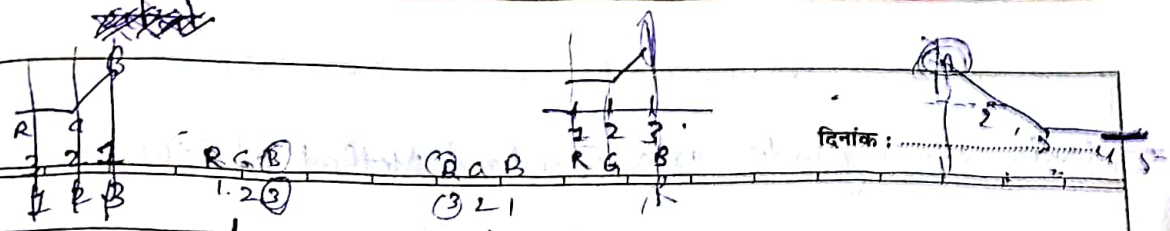
4 - 3 - 2



Combination R G B	object 1	object 2	object 3
3 2 1	B Yellow	Mag.	G Black/Grey
5 1 6	Green Blue White Black	Mag. Green	Green Grey/Black
4 5 1	Black	Red Mag.	Red Black
4 3 2			

for each object check for all the three R, G, B combinations

object 3 →



दिनांक : .....

Suppose in true color combination water is Blue

→ when the Band configuration is changed, water will look like Red color.

DN value close to 255 → Brighter Red color.
DN value close to 0 → Darker Red color

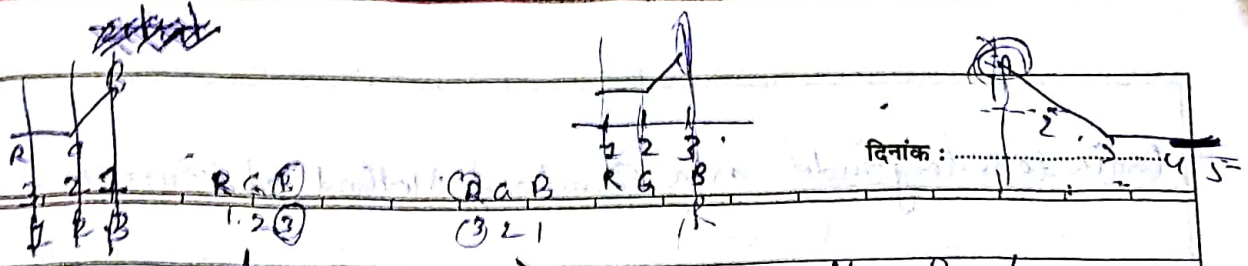
Grey scale Image → Same Band combination (R-G-B : 1-1-1)
(black to white with different shades of grey)

27/8/18 → Georeferences as Measurements.

- Some georeferences are Metric (They define location using measures of distance from fixed places)
- Unique, shared, Uniformly applicable
  [oceanic area, dense forest → No PINCODES]

Georeferencing system
1. Placenames
2. Postal address & postal codes
3. Linear referencing system
4. Latitude and longitude
5. Projections and coordinate System.
6. GPS

शिक्षक के हस्ताक्षर : .....



दिनांक : .....

Suppose in true color combination water is Blue

→ when the Band configuration is changed, water will look like Red color.

DN value close to 255 → Brighter Red color.
DN value close to 0 → Darker Red color

Grey scale Image → Same Band combination (R-G-B : 1-1-1)
(black-to white with different Shades of Grey)

27/2/18 → Georeferences as Measurements.

- Some georeferences are Metric (They define location using measures of distance from fixed places)

- Unique, shared, Uniformly applicable
[oceanic area, dense forest → No PINCODES]

Geo referencing system
(1) Placenames
(2) Postal address & postal codes
(3) linear referencing system
(4) Latitude and longitude
(5) Projections and coordinate system.
(6) GPS

शिक्षक के हस्ताक्षर : .....

Latitude & longitude as a Standard Method of Georeferencing.

→ Considering the whole system of referencing [centre, points etc.]
→ Earth is not a perfect sphere — not always true

In 1984, Standard about Earth shape, that was adopted by most of countries.

Projections & Coordinates

→ project the earth's surface onto a plane, rather than dealing with a curved surface.

Two types of projections are important in GIS

(1) Conformal property → Shapes of smaller features are preserved
(2) Equal area property → Shapes are distorted

Map projection

(1) Cylindrical
(2) Conical → problem (full globe cannot be mapped)
(3) Azimuthal → problem (full globe can't be mapped)

दिनांक : .....

→ The Mercator projection is the best known cylindrical projection.

→ The cylinder is wrapped around the equator.

(1) features in high latitudes are significantly enlarged (like Antarctica and Arctic region)

(2) shape is properly preserved. [for small features]

Conic projections →

→ latitude appear as Arcs of circle

→ used to map some part of continents (says Lambert mapping of North America)

→ Equator regions are not well mapped.

UTM (Universal Transverse Mercator) projection

→ put cylinder in a horizontal position

→ Max. distortion is 0.04 %

→ Transverse Mercator (Here cylindrical is wrapped around the poles, not the equator)

शिक्षक के हस्ताक्षर : .....

for shape & projection of Earth ⇒ Most satellite follow this.

Shape → WTS 1984 (Spherical)
Projection → UTM projection

→ In the projected image, we will find Easting and Northing information not in Latitude and Longitudes but these option are available in softwares.

→ In regional scale, Mapping through latitudes and longitudes are of a bit problematic because we are taking every reading with repect to the centre of the earth and a large scale mapping within a small range of latitudes & longitudes will generate much error.

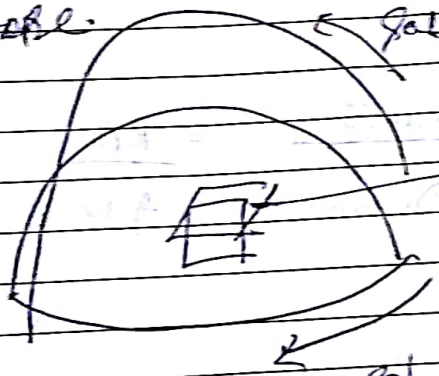
दिनांक : .....

Satellite Image acquisition

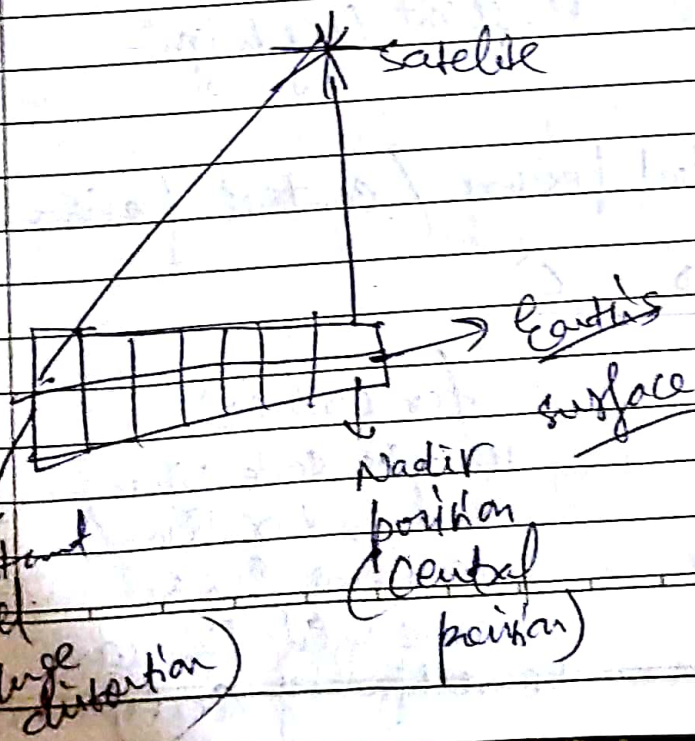
- Sources of distortion →

1. Earth rotation.
2. Sensor scan characteristics
3. Wide field
4. Curvature.

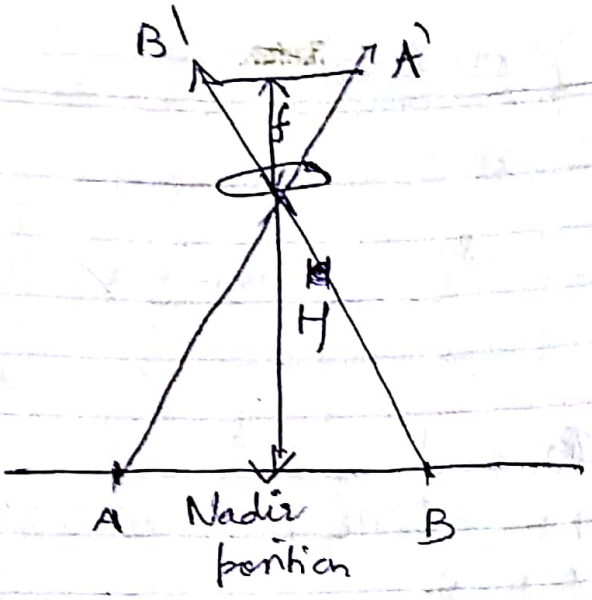
Systematic Errors.

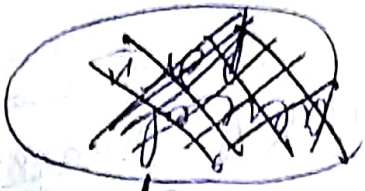


Square area is scanned as rhombus.



शिक्षक के हस्ताक्षर : .....





H = fly height

f = focal length

AB = ground distance

A'B' = photo Distance

$$\text{Scale} = \frac{\text{Photo distance}}{\text{Ground Distance}} = \frac{RB}{AB}$$

1 : 10000

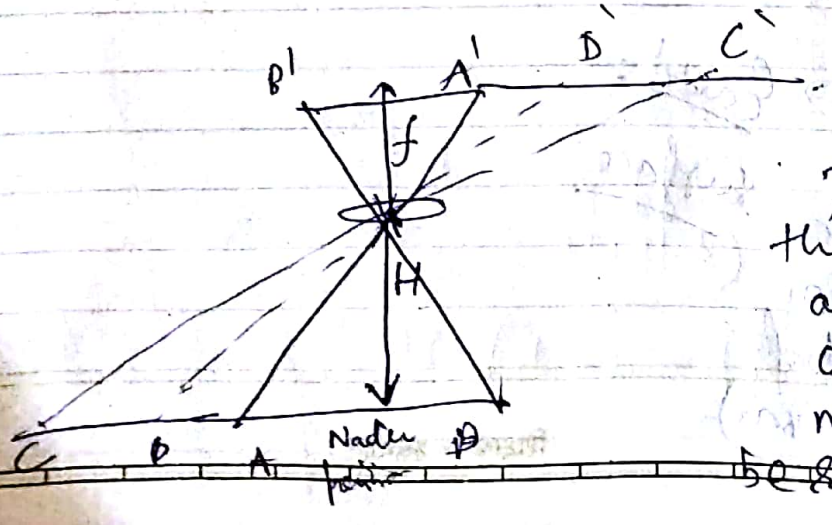
1 cm = 10000 cm

$$\frac{A'B'}{AB} = \frac{f}{H}$$ (By similar Δ'les)

f = focal length

H = flight / fly height

Nadir position is the vertical position / central position



for CD & C'D'

their is scale Distortion and similar Triangle conditions is not more valid. This can be rectified by

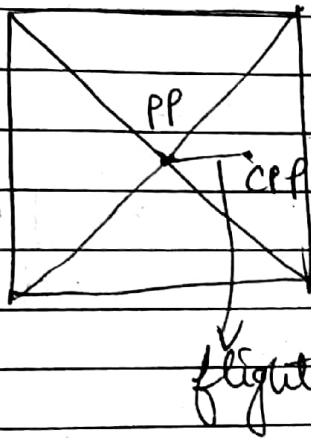
दिनांक : .....

Parallax → (Stereoscope)

18 →

Image Displacement →
A photo's central projection leads to image displacement.

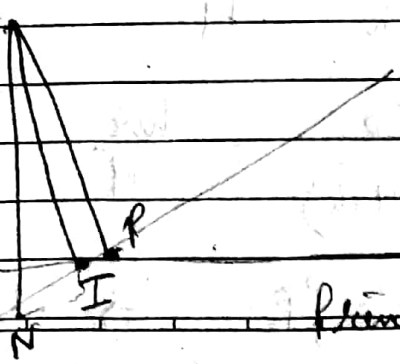
Radial position → Object will tend to lean outward
i.e be radially Displaced
Nadir ← [Center of photo — only Domes observed position



PP - principal point

CPP - conjugate principal point (in other photo, the point which was principal point in the former photo)

and almost 60% of overlap will be there between two Images.

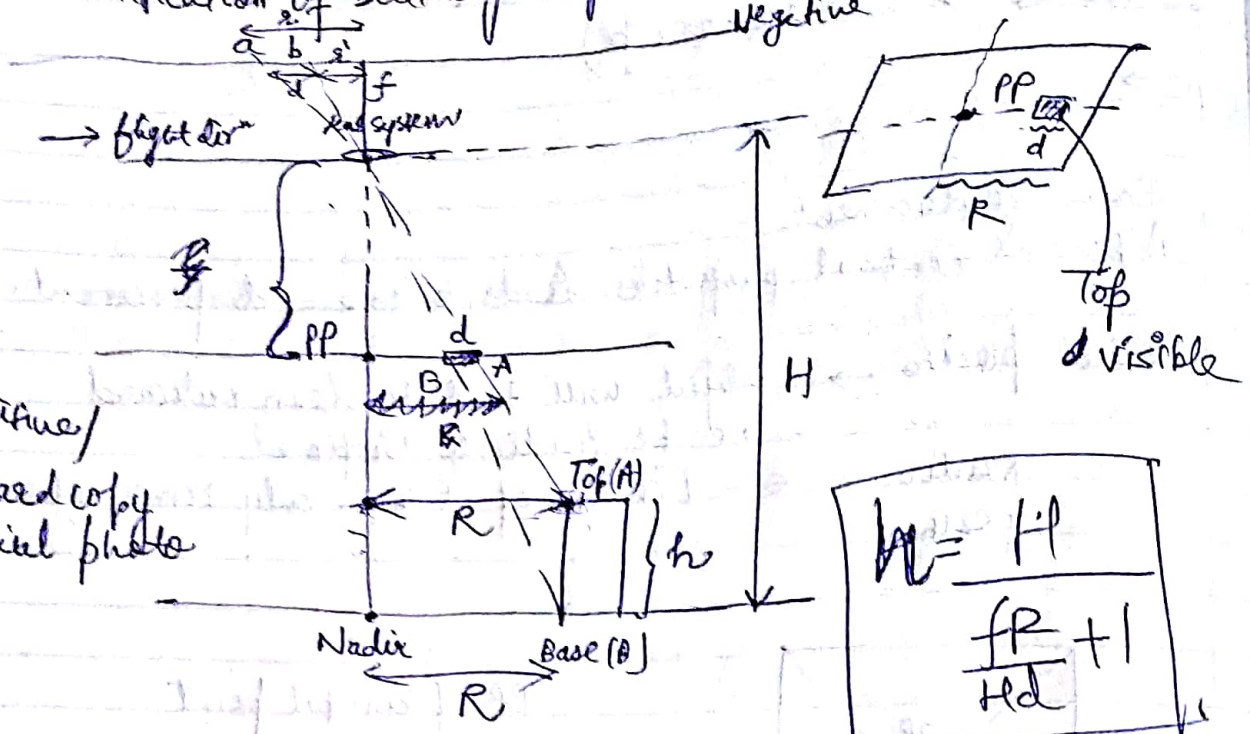


Isocenter is applicable when we have oblique view of field of view)

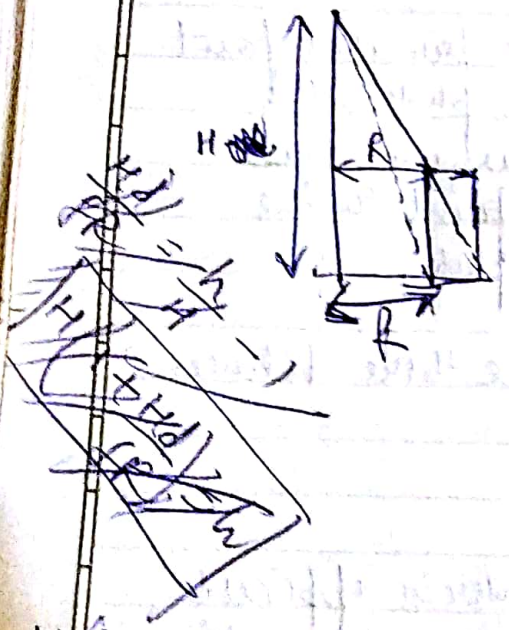
Principal point = P

शिक्षक के हस्ताक्षर : .....

Identification of Building Height.



$$h = \frac{Hd}{\frac{fR}{Hd} + 1}$$



$$\frac{f}{r} = \frac{H-h}{R} \qquad \therefore r = \frac{fR}{H-h}$$

$$f/r' = H/r \qquad \therefore r' = \frac{fr}{H}$$

$$d = r - r'$$

$$d = \frac{fR}{H-h} - \frac{fr}{H}$$

$$\frac{H(H-h)}{h} = \frac{fR}{d} \Rightarrow d = \frac{hfR}{H(H-h)} = \frac{hr}{H}$$

$$\frac{Hd}{h} = H - h \qquad \frac{Hd}{h}(H-h) = fR \Rightarrow H - h = \frac{fR}{d}$$

$$h = H - \frac{fR}{d}$$

दिनांक: .....

→ for vertical field of view, Nadir and principal point ~~is~~ coincide with each other.

Georeferencing → Registration of an Image to a known map coordinate system.

Identify some ground control points in original Image (well distributed)

Choice of control points

① Sufficient no of well defined control points.

Resampling

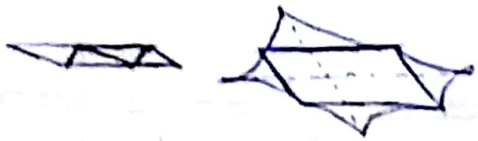
→ Transfer from Initial Coordinate system to a new coordinate system

new grid (Shifted grid)

Original Grid

Distortion & Rotation ⇒ Is taken care of by Resampling

शिक्षक के हस्ताक्षर : .....



Country Roads - John Denver
Winds of change - Scorpions
Prateek Kuhad - Bepanwah / Tune Kaha
Avril - Complicated / ... / ...
LP - one more Night / talking to myself
Porcupine Tree I Lazarus / Trains.