

Faculty of Engineering

Helwan University

Mattaria Branch

REMOTE SENSING REPORT

[From Sheet 1 to Sheet 5]

2nd Year of Civil Engineering

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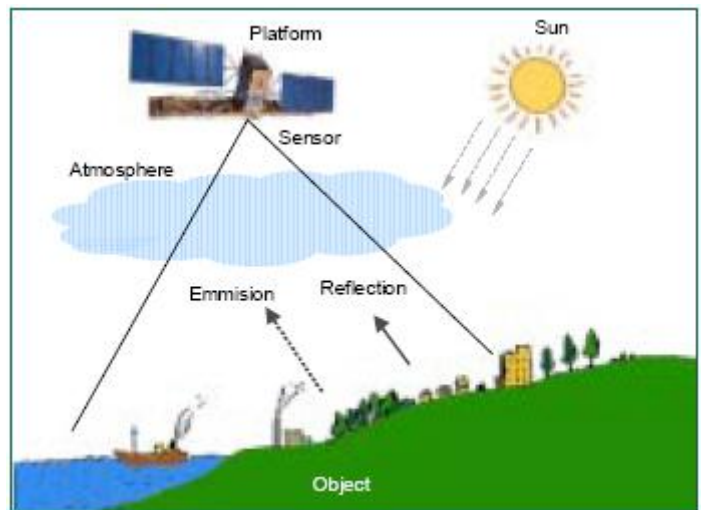
- Sheet 1 -

Q1) Define remote sensing .

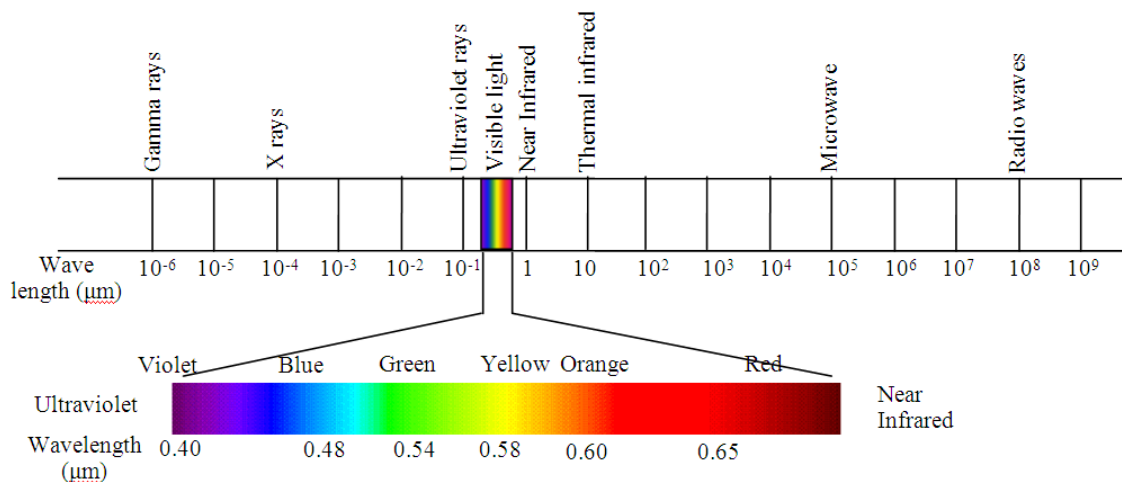
Remote sensing is an art and science of obtaining information about an object or feature without physically coming in contact with that object or feature

Q2) Explain with aid of drawings the remote sensing technique .

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



Q3) Draw a neat sketch for electromagnetic radiation spectrum



Q4) Compute in a table the energy range of the following electromagnetic waves :

Gama rays - X rays - UV - Blue - Green - Red - IR - (NIR- Thermal) - Microwaves - Radiowaves,

Given : Plank's constant (h) = 6.626×10^{-34} joules-sec

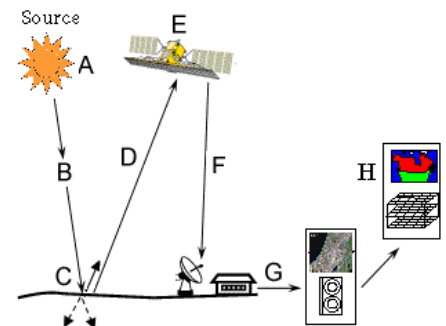
speed of light (C) = 3×10^8 m/sec

$$E = \frac{h \cdot C}{\lambda}$$

Waves	λ (μm)	E (Joule)
Gamma rays	10^{-6}	1.99×10^{-13}
X rays	10^{-4}	1.99×10^{-15}
UltraViolet rays	10^{-1}	1.99×10^{-18}
Blue rays	0.48	4.14×10^{-19}
Green rays	0.54	3.68×10^{-19}
Red rays	0.65	3.058×10^{-19}
Near Infrared	1	1.99×10^{-19}
Thermal Infrared	10	1.99×10^{-20}
Microwaves	10^5	1.99×10^{-24}
Radiowaves	10^8	1.99×10^{-27}

Q5) What are the important stages of remote sensing ?

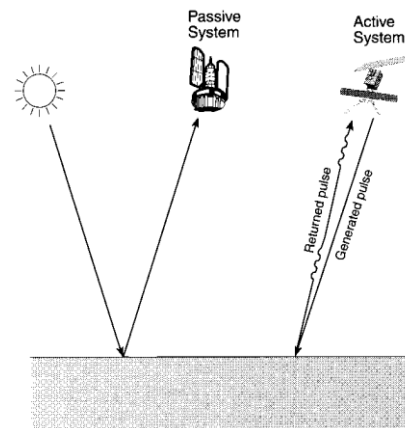
1. Emission of electromagnetic radiation
 - The Sun or an EMR source located on the platform
2. Transmission of energy from the source to the object
 - Absorption and scattering of the EMR while transmission
3. Interaction of EMR with the object and subsequent reflection and emission
4. Transmission of energy from the object to the sensor
5. Recording of energy by the sensor
 - Photographic or non-photographic sensors
6. Transmission of the recorded information to the ground station
7. Processing of the data into digital or hard copy image
8. Analysis of data



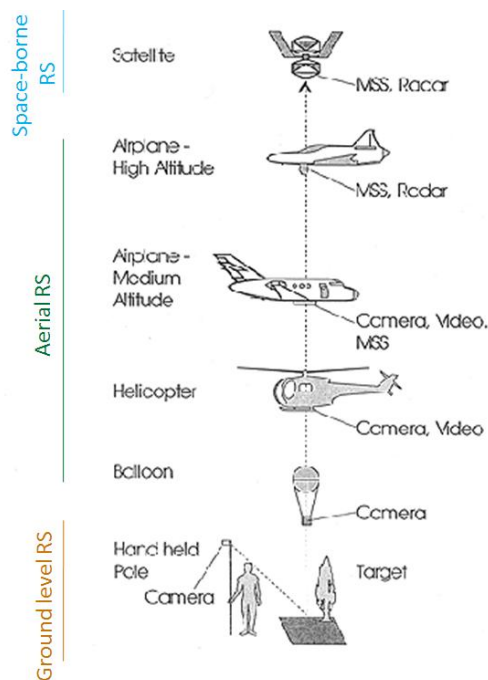
Q6) What are the types of remote sensing ?

1. Passive remote sensing

2. Active remote sensing



Q7) What are the types of remote sensing platforms ?



Q8) What are the advantages and disadvantages of remote sensing technique ?

*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

- Sheet 2 -

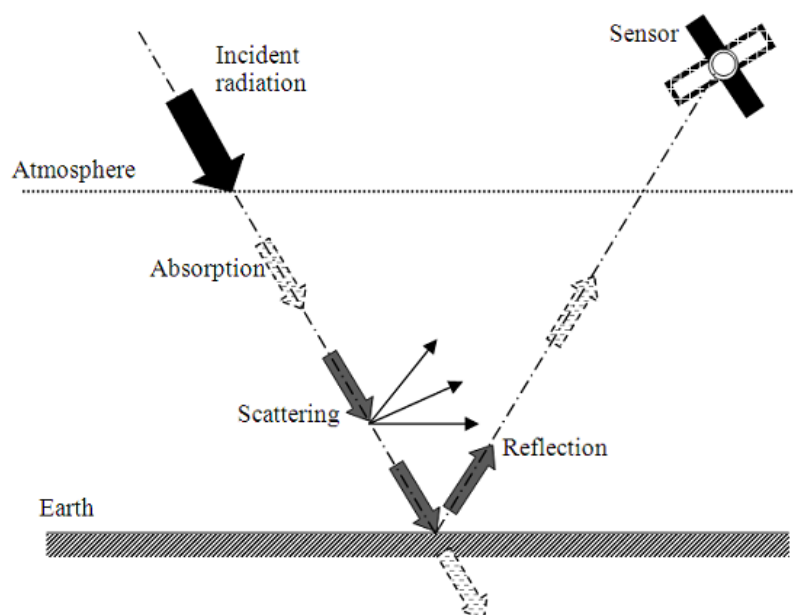
Q1) Define the black body according to remote sensing technology ?

جسم مثالي يمتص الاشعة الساقطة عليه ويخرجها مرة أخرى

Q2) What are the atmospheric window ?

The ranges of wavelength that are partially or wholly transmitted through the atmosphere

Q3) What is the interaction between EMR and the atmosphere ?



Q4) Explain in details the terminology of "Scattering" and indicates its type ?

scattering is the process by which small particles in the atmosphere diffuse a portion of the incident radiation in all directions.

*There are three different types of scattering:

- 1) Rayleigh scattering 2) Mie scattering 3) Non-selective scattering

Q5) What are the main factors that affect the selection of remote sensing sensors ?

While selecting a sensor the following factors should be considered:

i. The spectral sensitivity of the available sensors

ii. The available atmospheric windows in the spectral range(s) considered. The spectral

range of the sensor is selected by considering the energy interactions with the features

under investigation.

iii. The source, magnitude, and spectral composition of the energy available in the particular

range.

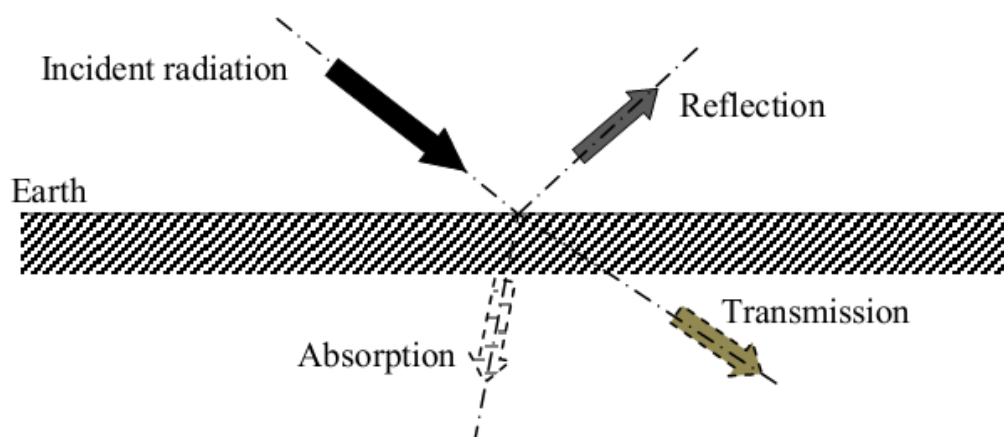
iv. Multi Spectral Sensors sense simultaneously through multiple, narrow wavelength ranges

that can be located at various points in visible through the thermal spectral regions

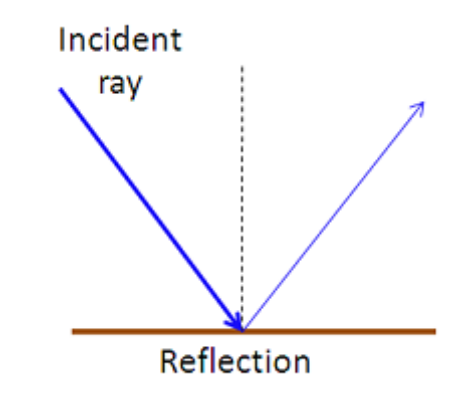
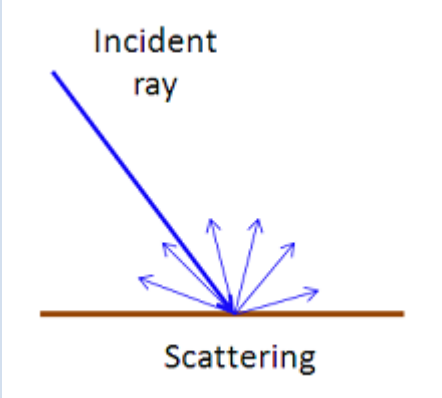
Q6) What is the general behavior of earth objects when they are subjected to EMR ? and what is the main factor affecting this behavior ?

* General Behavior :

- 1) Reflection 2) Absorption 3) Transmission



Q7) What is the difference between reflection and scattering ?

Reflection	Scattering
Reflection is the process in which the incident energy is redirected in such a way that the angle of incidence is equal to the angle of reflection. The reflected radiation leaves the surface at the same angle as it approached	Scattering is a special type of reflection wherein the incident energy is diffused in many directions and is sometimes called diffuse reflection
	

Q8) Explain the terms of : CC - TCC - FCC - Albedo

- CC : Color Composition

يتكون من 3 ألوان : (أحمر - أخضر - أزرق)

- TCC : True Color Composition

يتم دمج 3 صور من منطقة الأشعة المرئية ويتم إعطاء كل صورة (band) اللون الحقيقي لها

Blue band → Blue color

- FCC : False Color Composition

يتم دمج 3 صور لنفس المنطقة ويحدث فيها تغيير في الألوان لإظهار الاهداف المختلفة ذات اللون المتشابه في المنطقة

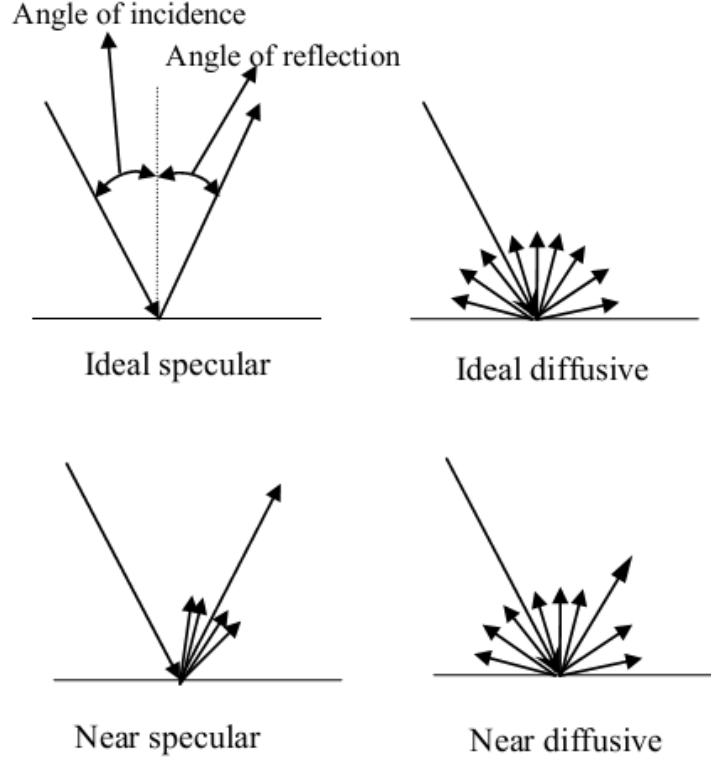
Blue band → Red color

Red band → Infrared color

Green band → blue color

- **Albedo** : يعبر عن خصائص انعكاس معالم سطح الارض بأنها هي النسبة بين الطاقة المنعكسة بواسطة السطح الى الطاقة الساقطة على السطح ويتم قياسها كدالة في الطول الموجي وتسمى الانعكاس الطيفي

Q9) What are the types of reflectors ?

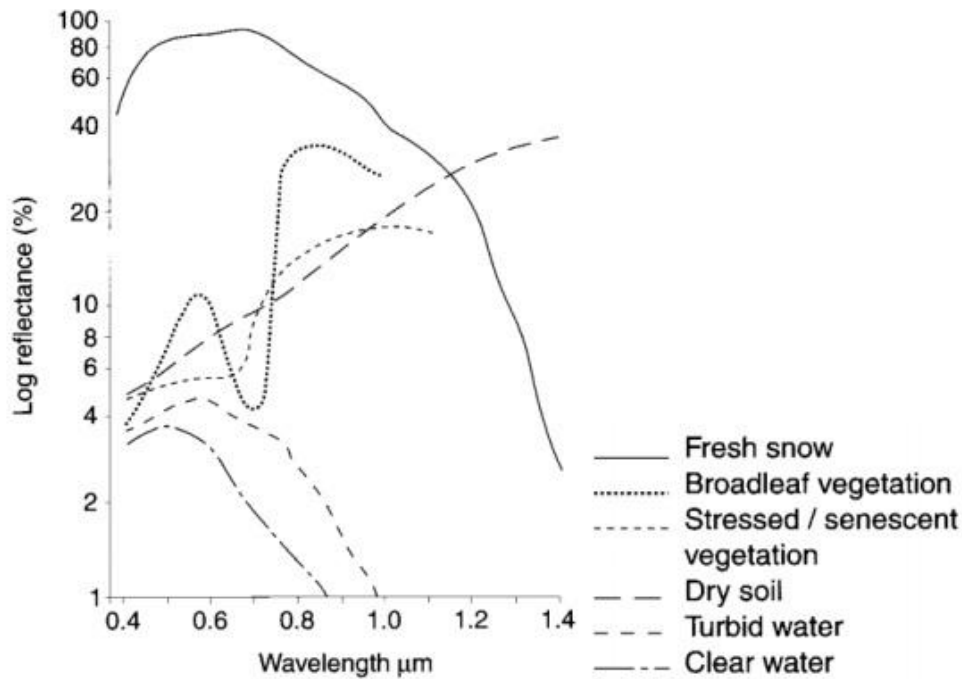


Q10) Why we can't use the green band to map plants ?

لأنه يقوم بإظهار النباتات والنجيل الصناعي باللون الأخضر وبالتالي لا يمكن التعرف على الهدف (النباتات) وبالتالي يتم استخدام (FCC) وتغيير اللون الأخضر في بند الأخضر بالـ (IR) الأشعة تحت الحمراء ← لأنها تتعرف على مادة الكلوروفيل في النبات

- Sheet 3 -

Q1) Draw a neat sketch for reflectance of a sample of natural features versus wave length .

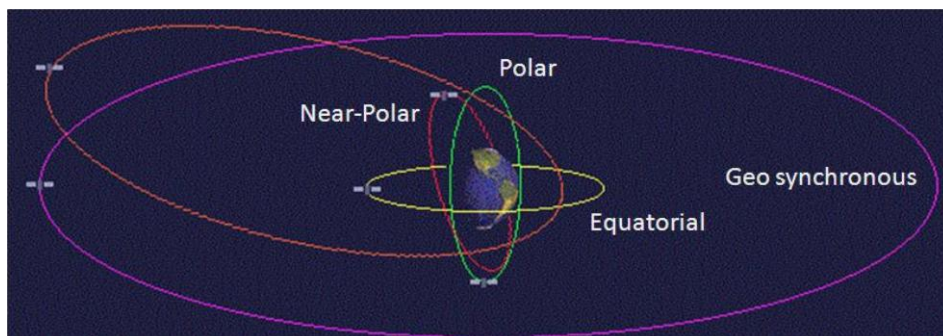
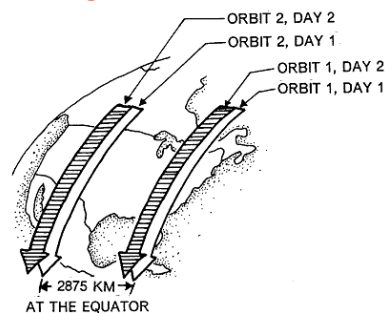


Q2) Explain how we can map river Nile path using remote sensing technology

يمكن لتقنية الريموت سينسج رسم الخرائط للمسطحات المائية وذلك باستخدام الأطوال الموجية للأشعة تحت الحمراء لأن طولها الموجي أكبر من 0.7m وبالتالي لها القدرة على امتصاص الأشعة الصادرة من المياه فتظهرها على هيئة لون اسود غامق.

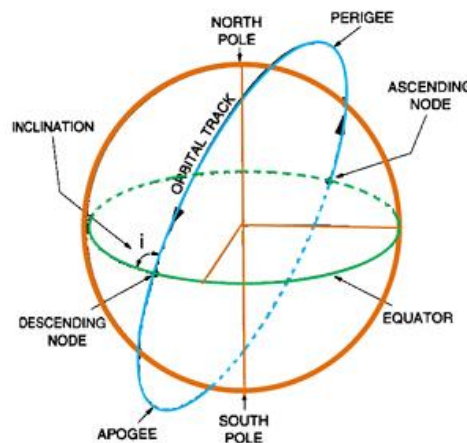
Q3) Draw a neat sketch for the following remote sensing satellite orbits :

- Geo-synchronous orbits
- Polar orbit
- Near-Polar orbit
- Equatorial orbit



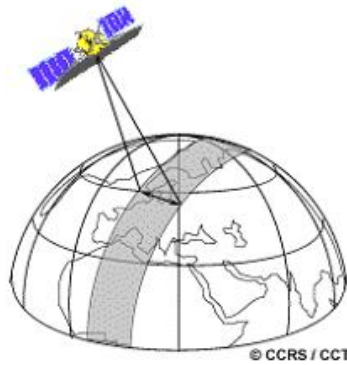
Q4) Define the following terms in remote sensing technology with the aid of drawing :

- **Orbital period** : Time taken by a satellite to complete one revolution in its orbit around the earth is called orbital period
- **Orbit** : The satellite path while moving around the Earth
- **Altitude** : Altitude of a satellite is its heights with respect to the surface immediately below it
- **Apogee** : the point in the orbit where the satellite is at maximum distance from the Earth
- **Perigee** : the point in the orbit where the satellite is nearest to the Earth
- **Inclination** : Inclination of the orbital plane is measured clockwise from the equator. Orbital inclination for a remote sensing satellite is typically 99 degrees. Inclination of any satellite on the equatorial plane is nearly 180 degrees



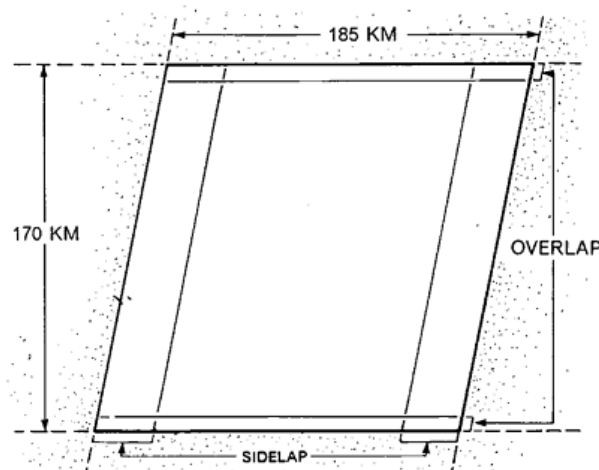
- **Nadir point** : the point of interception on the surface of the Earth of the radial line between the center of the Earth and the satellite
- **Zenith** : Any point just opposite to the nadir above the satellite
- **Ground track** : The circle on the earth's surface described by the nadir point as the satellite revolves

- **Swath** : Swath of a satellite is the width of the area on the surface of the Earth, which is imaged by the sensor during a single pass



- **Side lap and Over lap** : Overlap is the common area on consecutive images along the flight direction

Sidelap is the overlapping areas of the images taken in two adjacent flight lines



- **Spatial resolution** : it is a measure of the area or size of the smallest dimension on the Earth's surface
- **Spectral resolution** : ability of sensor to define fine wavelength interval
- **Radiometric resolution** : means how many grays levels are measured between pure black and pure white
- **Temporal resolution** : how often data obtained for same area
- **IFOV** : the angular cone of visibility of the sensor

Q5) Give one example for each type of remote sensing satellites :

- Low resolution

- Medium resolution

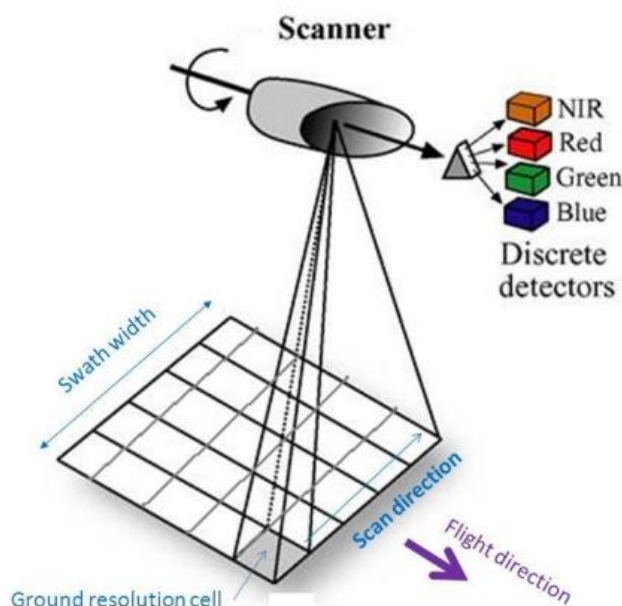
- High resolution

- Very High resolution

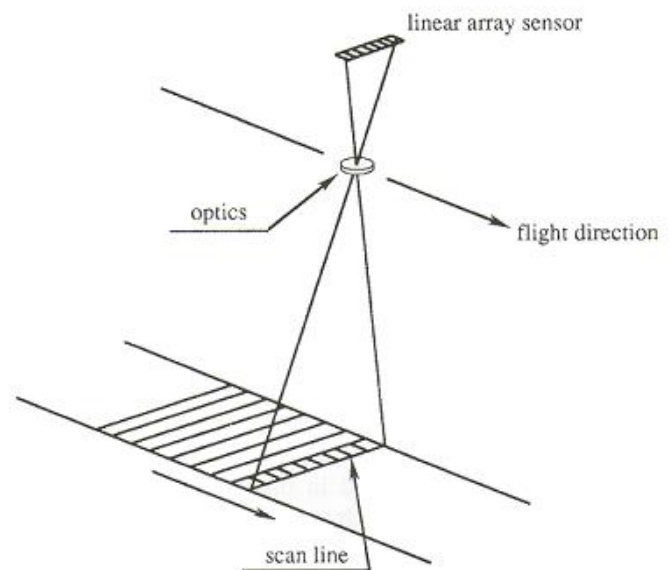
النوع	Low resolution	Medium resolution	high resolution	Very high resolution
الاستخدام	حالة الطقس	التعرف على النواعيات	الخرائط الطبوغرافية	الخرائط التفصيلية
مثال	MODIS & AVHRA	IRS WIFS	LAND SAT ETM	GEO EYE

- Sheet 4 -

Q1) Draw a neat sketch for one example for both along track and across track MSS imaging .



Across Track



Along-Track Scanning

Q2) Describe the characteristics of land sat ETM+7 satellite

Altitude = 705 Km

Bands → 1 - 8

Spatial resolution → B1 - B5 , B7 : 30 m

B6 : 60 m

B8 : 15 m

Radiometric resolution 8 bits

No. of orbits/day = 14

Q3) What is the use of thermal imaging in remote sensing ?

البحث عن نوعيات لها متغيرات حرارية مثل الانبعاثات الحرارية ، ومن اهم تطبيقاتها :

- Geological studies .
- Soil mapping .
- Soil moisture studies .
- Detect heat losses in buildings .

Q4) Compute the emissivity for a body in temperature of 300 °K if it emits 350 watt/m²

(hint : stefan-Boltzman's constant = 5.6697×10^{-8} watt m⁻² K⁴)

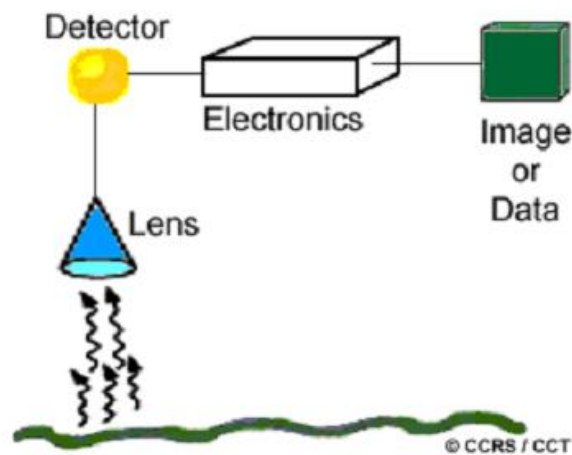
$$T = 300 \text{ }^{\circ}\text{K}$$

$$\sigma = 5.6697 \times 10^{-8}$$

$$M = \sigma \cdot T^4 = 5.6697 \times 10^{-8} \times (300)^4 = 459.23 \text{ watt/m}^2$$

$$\epsilon = \frac{\text{radiant exitance of an object at the museum}}{\text{radiant exitance of a blackbody at the same temp.}} = \frac{350}{459.23} = 0.76 \quad \epsilon = 76\%$$

Q5) Draw a neat sketch for thermal sensor



Q6) Describe the characteristics of spectral bands of SPOT 6 satellite

Band	Wavelength (μm)	Remark
PAN	0.45 - 0.745	Panchromatic
1	0.48 - 0.525	Blue
2	0.53 - 0.59	Green
3	0.625 - 0.695	Red
4	0.76 - 0.89	Near Infrared

Q7) What is the use of high resolution satellite ?

يستخدم في التخطيط الهندسي وعمل خرائط طبوغرافية

- Sheet 5 -

Q1) Map the following area that had been imaged with MSS image :

120	100	80	89
87	40	35	111
92	86	123	58
132	145	80	79

B1

201	99	109	32
110	140	55	66
36	85	120	111
80	145	60	38

B2

158	210	98	12
84	15	59	0
106	39	11	110
169	10	118	63

B3

188	123	80	120
86	40	35	45
10	33	100	18
0	56	89	98

B4

Spectral Classes' Table

Class	B1	B2	B3	B4	Radius	Color
A	120	200	150	198	50	Green
B	150	109	190	105	60	Red
Z	43	60	35	54	70	Blue

* FIRST PIXLE :

$$D_{1A} = \sqrt{(120 - 120)^2 + (200 - 201)^2 + (150 - 158)^2 + (198 - 188)^2} = 12.85 < 50$$

∴ GREEN

$$D_{1B} = \sqrt{(150 - 120)^2 + (109 - 201)^2 + (50 - 158)^2 + (105 - 188)^2} = 131.47 > 60$$

∴ UNKNOWN

$$D_{1Z} = \sqrt{(43 - 120)^2 + (60 - 201)^2 + (35 - 158)^2 + (54 - 188)^2} = 242.68 > 70$$

∴ UNKNOWN

∴ THE COLOR OF PIXLE IS GREEN

GREEN	RED	BLACK	BLACK
BLACK	BLACK	BLUE	BLACK
BLACK	BLUE	BLACK	BLACK
BLACK	BLACK	BLACK	BLUE