Internal Assessment Test - 03

QUESTION-2

The satellite transmission equation contains the involvement of multiple factors for its received power gain, the receiver power dependent on the attenuation factor.

The transmission equation is just an assumption of the statistical characteristics when the reception of the receiver power flux density (P_{RD}) is involved and can be described as follows,

$$P_{RD} = \frac{P_T G_T}{4\pi d^2} \quad \text{——— (1)}$$

where, d is the distance of separation of the satellite transponder from the surface of the Earth

P_T is the power transmitted

G_T is the transmitter gain

The unit of measurement of P_{RD} is given by W/m^2.

Assuming the receiver power, we have a factor A_R (attenuation factor) multiplied to the P_{RD} to get P_R (receiver power).

$$P_R = P_{RD} \times A_R$$

$$P_R = \frac{P_T G_T}{4\pi d^2} \times A_R \quad \text{——— (2)}$$

But the value of A_R can be obtained from the Gain of the receiver.

$$G_R = \frac{4\pi A_R}{\lambda^2} \quad \text{——— (3)}$$

$$\Longrightarrow A_R = \frac{G_R \lambda^2}{4\pi} \quad \text{——— (4)}$$

Substituting (4) equ. value in equ. (2), we get:

$$P_R = \frac{P_T G_T}{4\pi d^2} \times \frac{G_R \lambda^2}{4\pi}$$

$$P_R = \frac{P_T G_T G_R}{\frac{4^2 \pi^2 d^2}{\lambda^2}}$$

$$P_R = \frac{P_T G_T G_R}{\left(\frac{4\pi d}{\lambda}\right)^2} \quad \text{---------- (5)}$$

$$P_R = \frac{P_T G_T G_R}{L_p} \quad \text{---------- (6)}$$

where, L_p is the path loss constant defined by,

$$L_p = \left(\frac{4\pi d}{\lambda}\right)^2$$

Applying log on both sides of eqn. (6), we get:

$$10 \log P_R = 10 \log P_T + 10 \log G_T + 10 \log G_R - 10 \log L_p$$

The $10 \log P_T + 10 \log G_T$ can be the output of the EIRP (Effective isotropic radiated power) in dBW

$$P_R \text{ (in dBW)} = \text{EIRP (in dBW)} + G_R \text{ (in dB)} - L_p \text{ (in dB)} \quad \text{---------- (7)}$$

Considering the path loss in the attenuation, transmitter and receiver sides, we finally get the eqn. (7) as follows:

$$P_R = EIRP + G_R - L_p - L_A - L_T - L_R \quad \text{— (3)}$$

where,

P_R - received power

$EIRP = P_T \times G_T$ - Effective Isotropic Radiated power

G_R - Gain of the receiver

L_p - path loss

L_A - attenuation loss

L_T - transmitter loss

L_R - receiver loss.

QUESTION-6

Applications of Weather Forecasting Satellites:

Weather forecasting Satellites are of major help when it comes in monitoring the fluctuations of the climatic conditions over a continous periods or time intervals to predict any unmannerly change in the environment.

Some of the major Application of Weather Forcasting Satellites are as follows:

(i) Rainfall
(ii) Wind speed and Direction
(iii) Severe storm support
(iv) Fog
(v) Measurement of Cloud Parameters
(vi) Snow and Ice Studies
(vii) Ground Level Temperature Measurement
(viii) Predicting Disasters
(ix) Oceanography

(i) Rainfall :

* The continous monitoring of the weather intur helps in early prediction of rainfall, thunderst hurricanes
* The probability of how effectively or at whe probable moment or time duration, a cyclone m hit the particular location is also being done by the Weather Forecast satellite
* The most commonly used source of light are Visible and IR rays.

(ii) Wind speed and direction:

* The continous capture of images of the place being suffering by severe wind or hurricanes are being captured
* Depending on the cloud movement, we are able to predict the direction by which the wind is supposed to move and also estimate the speed of movement of the clouds.

(iii) Severe storm support:

* During the time of heavy storms and rainfall, the wind pattern and the intensity of the storm are continously monitored
* They can be helpful for NGO's for disaster prediction by storm and save the life of people being settled at that particular location of storm approachable

iv) Fog:

* An early indication of the air pollution content and haze in the atmosphere can be helpful in predicting the probability of fog formation
* Major metropolitian cities are majorly affected by fog condition.

(v) Measurement of Cloud Parameters:

* The cloud parameters majorly define the brightness level of the cloud, depending on the thickness and the position of the clouds.
* A low-lying warm cloud are much brighter in appearance
* A low-lying cold cloud are very brighter in appearance
* A high-lying thick cloud is seemed to be very darker in appearance.

(vi) Snow and Ice studies:

* Weather forecast at the polar regions are of help for the studies of the snow and ice formation or the glaciers being liquified due to change in climatic conditions

(vii) Ground Level Temperature Measurement:

* The measurement of temperature helps in the predicting the avg temperature of particular area of interest.
* This helps in having a general idea of how hotter or colder our area of interest is being

located at

(viii) Predicting Disasters:

* Disaster prediction is one of the major task undergone by Weather forecast to monitor the weather of that particular location
* Disaster management intern helps in predicting Earthquakes, Tsunami, Rainfall, Cyclone, and so on

(ix) Oceanography:

* The study of the ocean characteristics including its aquatic and surrounding biosphere due to the variation in temperature can be called an Oceanography
* A complete statistical study on the observations and identifying any changes is being performed here.

QUESTION-1

(i) Demand assigned FDMA:

* FDMA system uses Frequency Division method for Multiplexing Accessing. Here, specifically, the demand assigned FDMA follows certain procedures for the transponder frequency being assigned to

the Earth station through multiple channels

* The transponder frequency is first subdivided into multiple channels to the Earth station depending on the request being arose from the Earth station.
* The demand assigned FDMA uses two different techniques for its implementation. They are:
  (a) Polling Method
  (b) Distribution Method
* In Polling Method, every time the channel visits the Earth station to check if the requests are raised at the Earth station periodically. The main disadvantage with polling method is the introduction of delays.
* In distribution Method, they are further classified into 2 subcategories as follows:
  (a) Centrally Distributed Method
  (b) Distributed Method
* This method is able to overcome the drawbacks of delays of the Polling method of demand assigned FDMA.

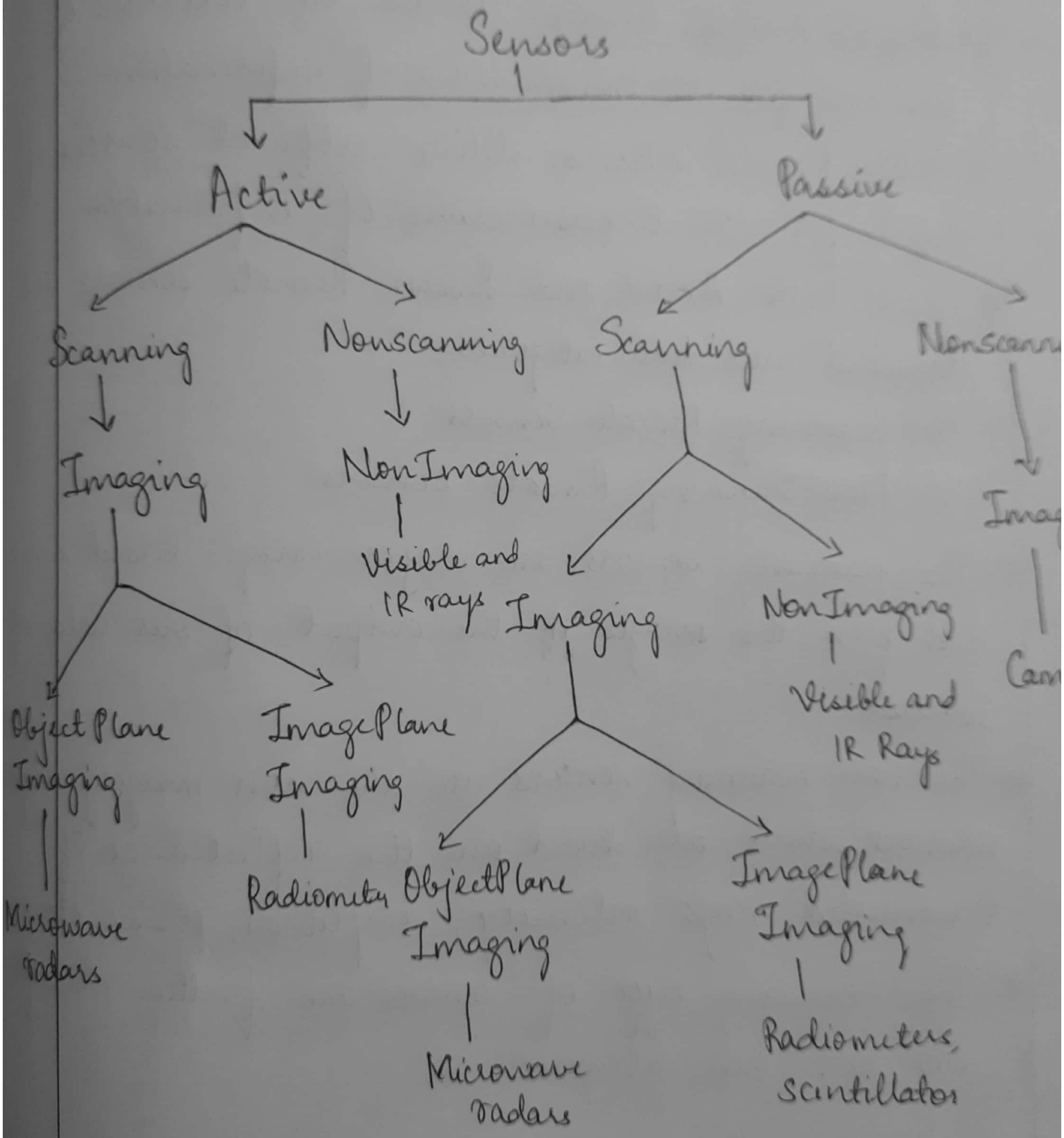
* In Central Method, one Earth station is being assigned as Master and all other Earth stations are its sub-members, this master Earth stations collects all the data from its sub-member Earth stations and processes it.
* In Distributed Method, all the Earth Stations are equally assigned the power to deliver data to the Earth Station's Satellite Transponder.

(ii) Pre-assigned FDMA:

* In pre-assigned FDMA system, the satellite transp has no pre-assigned frquency channels assigned the Earth station.
* Every time an information is being processed and transmitted to the satellite from Earth Station without any prior intimation to any other channels of the same Earth station
* This method intern reduces the delays associa with the demand-assigned FDMA's Polling Method.

QUESTION-3

Classification of Sensors used in Remote Sensing Satellite:



* The first type of classification of sensors include
  (i) Passive Remote Sensors
  (ii) Active Remote Sensors
* Passive Remote Sensors utilize the radiation of the sun for its transmission of information.
* Active Remote Sensors utilize artificial sources of light for its transmission of information.
* These both, Active and Passive Remote sensors are classified into two categories:
  (a) Scanning Remote Sensors
  (b) Non-scanning Remote sensors
* The scanning sensors are major image based sensors and form the images of the output of our area of interest.
* The non-scanning sensors are the non-imagery type scanners which are based on the reflecteance of transmitted rays intensity, amplitude, phase, etc...
* The Scanning type of sensors are further classified into two sub categories as:

(a) Imaging (always)
(b) Non-Imaging (sometimes)

The Imaging category of Remote sensors utilize the images outcomes for their analysis
The Non-Imaging category are of electromagnetic radiation dependent.

The Imaging category of Remote sensors are further bifurcated depending on what type of image is being deployed on the output image.
They are:

(a) Object Plane Image Remote Sensing
(b) Image Plane Image Remote Sensing

The Object Plane Images gives the image of the vegetation, forestry, climatic conditions, soil conditions, river flow information of a particular area of interest which is being observed by the Remote satellite.

* The Image Plane Images gives the image of the the ground level occupied for what purpose, for instance, the cities are being occupied by buildings whereas, the deserts remain barren and dusty.

* The Non-Imagery type always predicts the output depending on the climatic conditions prevalant over that area of interest like the weind speed or direction, the change in cloud parameters, etc---.
* The Object Plane Images uses Microwave Radars, whereas the Image Plane Images uses Radiometers and Scintillators for measuring the performance analysis.
* The Non-Imaging type just uses the Visible and IR rays to fetch the output of the present area of interest.

QUESTION-5

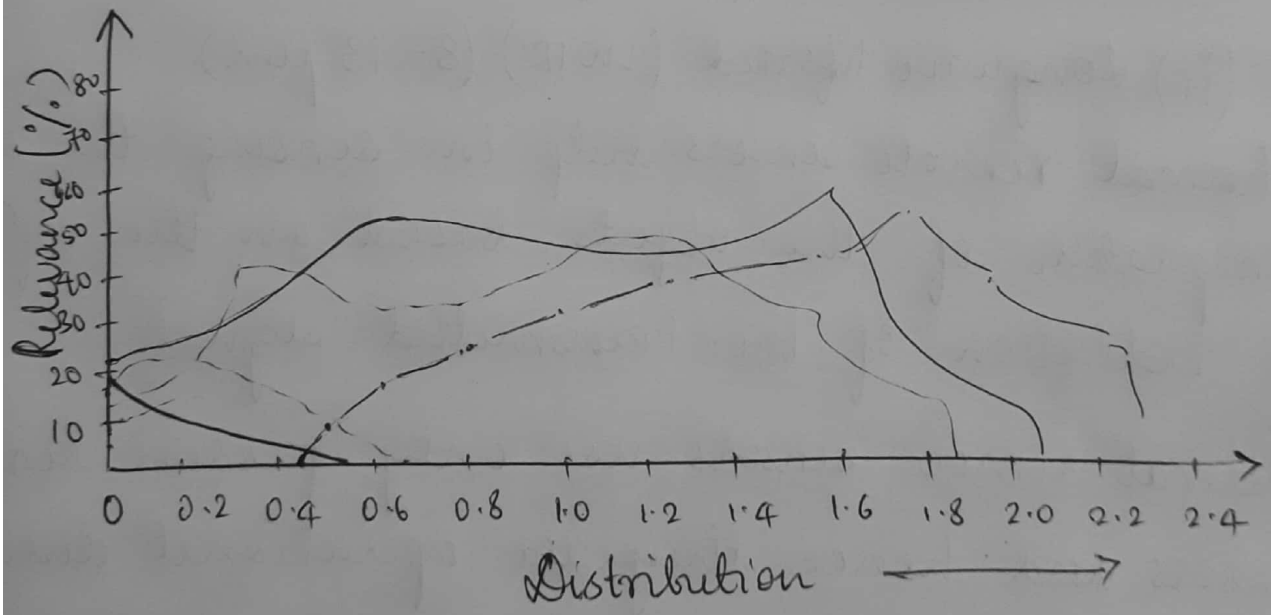
(i) Optical Remote Sensing:

* Optical Remote Sensing uses only these three regions for their operation:
  (i) Visible (0.3 - 0.7 μm)
  (ii) Infrared (IR) (0.72 - 1.3 μm) and
  (iii) Shortwave Infrared (SWIR) (1.3 - 3 μm)

The optical remote sensors use both active and passive sensors for their operation and hence these optical sensors operate both during day and

night.

* During day time, the passive sensors provide the sun-light reflectance for information transmission
* During night time, in the absence of sun, the active sensors, illuminate the light from artificial sources of light.
* A graph below illustrates the sensing of the multiple geographical features of our area of interest on the Earth surface.



— Clear River Water
- - - Turbid River Water
—— Vegetation
—·— Misty sand
——·—·— Cultivation

* The relevance % for the distribution of vegetation is being shown here and also the other key factors like sand type, river water and its types, etc..
* This inturn is the major application of Optical Remote Sensors

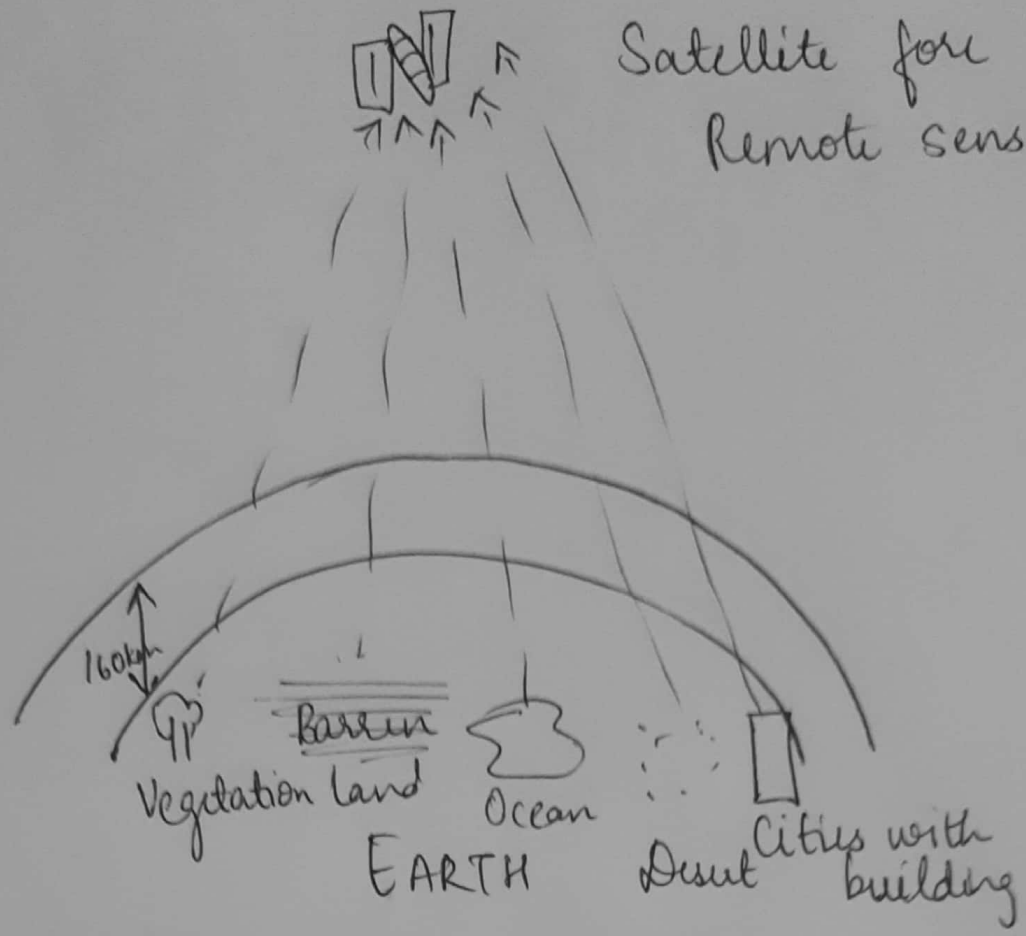
(ii) Thermal Remote Sensing:

* Thermal Remote sensing use only these two regions for their operation:
  (i) Midwave IR (5-8 μm)
  (ii) Longwave Infrared (LWIR) (8-13 μm)

Thermal remote sensors help in sensing the surface temperature of the objects based on the reflectance of radiation of the transmitted signal

Thermal remote sensors use only passive remote sensors and hence they are operational during day time only as passive sensors use sun as their source of radiation for transmitting information

An image of thermal remote sensing is being shown below which shows the reflectance from 5 different region to the satellite from Earth station



* These satellites differentiate the vegetation of areas using temperature as a referenc
* The deserts are expected to be at a higher t for as compared to cities, and vegetation
* Oceans are comparitively at a lesser tempe compared to all the land covers as it is much cooler, in the above fig
* Thus, thermal remote sensors are basically to distinguish the different areas based on temperature measurement and analysis.