# UNIT-I
# SATELLITE ORBITS
## PART A

1. **State Kepler's third Law. (Nov/Dec2015)**
   - Kepler's third law states that the square of the periodic time of orbit is proportional to the cube of the mean distance between the two bodies.
   - The mean distance is equal to the semi major axis a. For the artificial satellites orbiting the earth, Kepler's third law can be written in the form a3 = μ / n2
   - Where n is the mean motion of the satellite in radians per second and μ is the earth's geocentric gravitational constant.

2. **Define Apogee and Perigee. (April / May 2015)**
   - **Apogee :** The point on the elliptical orbit, which is the farthest from the center of the earth. Apogee distance ha = a(1+e)
   - **Perigee :It is the** point on the orbit that is nearest to earth. The perigee distance for a elliptical orbit is given by hp = a(1-e);

     Where e – eccentricity of the orbit. A – semi major Axis.

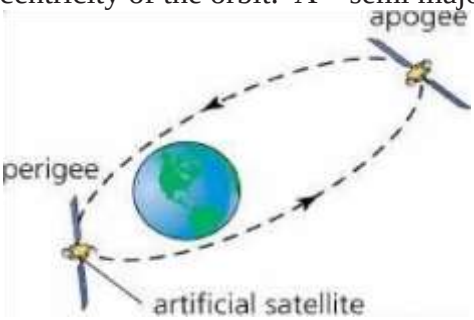


**Figure : Apogee and Perigee**

3. **Write the equation for total energy of a satellite for a two body system. (Nov/Dec2015)**

$$E_{tot} = \frac{1}{2}m_1\dot{\mathbf{x}}_1^2 + \frac{1}{2}m_2\dot{\mathbf{x}}_2^2 + U(\mathbf{r}) = \frac{1}{2}(m_1+m_2)\dot{\mathbf{R}}^2 + \frac{1}{2}\mu\dot{\mathbf{r}}^2 + U(\mathbf{r})$$

Where **m**1 and **m** 2 are their masses and **r** their distance

4. **List out the frequency bands used for satellite services. (April / May 2015)**

| Frequency range, | (GHz) Band designation |
|---|---|
| 0.1–0.3 | VHF |
| 0.3–1.0 | UHF |
| 1.0–2.0 | L |
| 2.0–4.0 | S |
| 4.0–8.0 | C |
| 8.0–12.0 | X |
| 12.0–18.0 | Ku |
| 18.0–27.0 | K |
| 27.0–40.0 | Ka |

5. **What are the features of Polar orbiting satellite. (May /June 2014)**
   - Polar orbiting satellites are satellites which orbit the earth in such a way to cover the north and south Polar Regions.
   - They are used for environmental monitoring and search and rescue services.
   - Since the orbit is lower than the Geostationary satellites, the data resolution is higher.
   - They provide global coverage for climatic studies.

6. **Define right ascension of ascension node. (May /June 2014)**
   - To define completely the position of the orbit in space, the position of the ascending node is specified.
   - However, because the earth spins, while the orbital plane remains stationary, the longitude of the ascending node is not fixed, and it cannot be used as an absolute reference.
   - However, for an absolute measurement, a fixed reference in space is required. The reference chosen is the first point of Aries, otherwise known as the vernal, or spring, equinox.
   - The vernal equinox occurs when the sun crosses the equator going from south to north, and an imaginary line drawn from this equatorial crossing through the center of the sun points to the first point of Aries.

7. **Calculate the radius of a circular orbit for which the period is 1 day.(Nov/Dec 2014) Given : 1 day.**

$$\omega = \frac{2\pi}{1\,day} = 7.272\,10^{-5}\ rad/sec$$

Using $\mu = 3.986005 \times 10^{14}\ m^3/s^2$

$$\therefore a = \left[\frac{\mu}{\omega^2}\right]^{1/3} = 42241\ldots\ km$$

8. **What is prograde orbit? (Nov/Dec 2014)**
   - An orbit in which the satellite moves in the same direction as the earth's rotation.
   - Theprograde orbit is also known as a direct orbit.
   - The inclination of a prograde orbit always lies between 0°and 90°.
   - Most satellites are launched in a prograde orbit because the earth's rotational velocity provides part of the orbital velocity.

9. **How is the world divided to facilitate frequency planning for satellite services? (May/June 2013)** The world is divided in to three regions
   - Region1: Europe, Africa,(formerly the Soviet Union)and Mongolia
   - Region 2: North and South America and Greenland
   - Region3: Asia, Australia, and the south- west Pacific

10. **What are Julian Dates? (May/June 2013)**
    - Calendar times are expressed in UT, and although the time interval between any two events may be measured as the difference in their calendar times, the calendar time notation is not suited to computations where the timing of many events has to be

computed.

- What is required is a reference time to which all events can be related in decimal days. Such a reference time is provided by the Julian zero time reference, which is 12 noononJanuary1intheyear4713 B.C.
- The important point is that ordinary calendar time are easily converted to Julian dates, measured on a continuous timescale of Julian days.

**11. Define orbital Parameters.**

In order to mention the position of the Earth orbiting satellites some parameters are used and these are termed as orbital parameters. They are

- Semi Major Axis, Eccentricity, Mean Anomaly, Inclination, Argument of Perigee & Right Ascension of Ascending Node

**12. What are the Orbital Perturbations?**

The Keplerian orbit is ideal; it assumes that the earth is a uniform spherical mass resulting from the satellite motion balancing the gravitational pull of the earth. But in practical Some disturbance and forces are changes the orbital positions.

- They are the gravitational forces of the sun and the moon and atmospheric drag.
- The gravitational pulls of sun and moon have negligible effect on low-orbiting satellites, but they do affect satellites in the geostationary orbit.
- Atmospheric drag, on the other hand, has negligible effect on geostationary satellites but does affect low- orbiting earth satellites below about 1000 km.

**13. How to represent the geocentric-equatorial coordinate system?**

- The geocentric-equatorial coordinate system is an inertial system of axes, the-reference line being fixed by the fixed stars.
- The reference line is the line of Aries. This is a very slow rotation.
- With the origin lying at the center of the earth, as would be used for close in terrestrial satellites, a geocentric system is obtained.
- Two geocentric coordinate systems are called equatorial or elliptic depending on whether the plane of the elliptic is used as respective reference plane.

**14. What is sub satellite point?**

- The sub satellite point is the location on the surface of the earth that lies directly between the satellite and the centre of the earth.

Figure shows the meridian plane which cuts the sub satellite point.

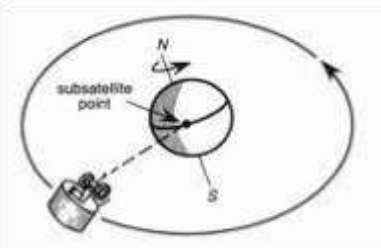


**Figure : Sub Satellite Point**

**15. Define sidereal Day.**

- The sidereal day is defined as one complete rotation of the earth relative to the fixed stars.
- One sidereal day has 24 sidereal hours,1 sidereal hour has 60 sidereal minutes and 1 sidereal minutes has 60 sidereal seconds. Generally, a sidereal day has 23h, 56 min.

**16. Write the advantages of Geo Stationary orbit.**

Advantages of Geo Stationary orbit are

- Tracking equipment avoided
- Earth stations at constant distance and remain atline of sight
- Larger coverage area
- Global coverage with less no. of satellites.
- Same quality of service at all places
- No Doppler shift, Cost effective.

**18. How the satellites are affected due to Atmospheric drag?**

- For near-earth satellites, below about 1000 km, the effects of atmospheric drag are significant.
- Because the drag is greatest at the perigee, the drag acts to reduce the velocity at this point, with the result that the satellite does not reach the same apogee height on successive revolutions.
- The result is that the semi major axis and the eccentricity are both reduced. Drag does not noticeably change the other orbital parameters, including perigee height.

**19. What are the basic concepts determining the look angles and its ranges?**

The coordinates to which the earth station antenna must be pointed to communicate with a satellite are called look angles, the following concepts determines the look angle.

- Orbital elements.
- Various measures of time.
- The peri-focal coordinate system, which is based on the orbital plane.
- The geocentric-equatorial coordinate system, which is based on the earth's equatorial plane.
- The topo centric- horizon coordinate system, which is based on the observer's horizon plane.

**20. What are Look angles? Define Them.**

- The coordinates to which the earth station antenna must be pointed to communicate with a satellite are called look angles.
- These are most commonly specified as Azimuth and Elevation angles.

  **Azimuth Angle**:It is defined as horizontal pointing angle of an earth station antenna.

  **Elevation Angle**:It is the vertical angle formed between direction of travel of an EM wave radiated from and earth station antenna pointing directly towards a satellite and the horizontal plane.

**21. Write the advantages and disadvantages of Satellite Communication.**

A Satellite is a physical object that revolves around some celestial body. A satellite which

is used for communication purpose is called communication satellites. The advantages and disadvantages are as follows **Advantages:**

- Wide Area of Coverage.
- Point to Multipoint Links whereas many terrestrial links are point to point.
- Mobile Communication can be established.
- Economical when long distance is involved.
- For Geo Stationary Satellite Doppler shift is negligible.

**Disadvantages:**

- Propagation delay is very high.
- Impedance mismatch + Propagation delay produces echo in telephone systems.
- Echo Suppressors or Echo chancellors are to be added so that complexity Increases.
- Propagation Delay reduces the efficiency of the data transmission over satellite communication

**22. State Kepler's first and third law.**

Kepler's I law:

It states that the path followed by the satellite around the primary will be an ellipse. An ellipse has two focal points F1, & F2. The center of mass of the two body system, termed the barycenter is always centered on one of the foci. The eccentricity, e is,

$$e = \frac{\sqrt{a^2 - b^2}}{a}$$

Kepler's III Law:

It states that the square of the periodic time of orbit is proportional to the cube of the mean distance between the two bodies, $a^3 = \mu/n^2$ where, n= meanmotion of the satellite in rad/sec.

$\mu$ = earth's geocentric gravitational constant.

With n in radians per second, the orbital period in second is given by, $P = 2\pi/n$

**23. What is the limit of visibility?**

The east and west limits on the geostationary are of a satellite that is visible from any given Stations are known as limits of visibility.

**24. Define azimuth angle. (April / May 2015)**

The coordinates to which the earth station antenna must be pointed to communicate with a satellite are called look angles.

- Azimuth angle is defined as the horizontal pointing angle of an antenna.
- It is the angle between true (geographic) south or north and the point on the horizon directly below the sun.

## PART B

1. (a)Describe the effect of orbit perturbations due to the effect of a non-spherical earth and atmospheric drag.(8) (APRIL /MAY 2015)
   (b) Explain what is meant by apogee height and perigee height. A satellite has an apogee of 39,342 km and a perigee of 613Km. Determine the semi major axis and the eccentricity of its orbit(Earth radius = 6371 km).(8) (APRIL /MAY 2015)
2. (a)Describe the method of finding the position vector R of the Earth relative to the IJK frame. (8)(APRIL /MAY 2015)
   (b) Explain the launching procedure for putting the GEO satellites in the orbit. (8) (Nov/Dec2015)
3. hat are the orbital parameters? Derive the expression for orbital equation of the satellite starting from Newton's law.(16) (Nov/Dec2015)
4. (a)Explain about frequency allocations for satellite services.(8)( MAY /JUNE 2014)
   (b)Explain about U.S.Domsats. (8)(MAY /JUNE 2014)
5. Explain in detail about orbital elements and orbital perturbations with suitable example. (16)(MAY /JUNE 2014)
6. (a)Explain the three Kepler's law with relevant diagrams (6) (NOV/DEC 2014)
   (b) For a particular satellite the eccentricity is $9.5981 \times 10^{-3}$ and the mean anomaly is 204.9779*.The mean motion is 14.2171404 rev/day. The semimajor axis is 7194.9Km calculate the true anomaly and the magnitude of the radius vector 5s after epoch. (6) (NOV/DEC 2014)
   (c) Write a brief note on Julian dates. (4) (NOV/DEC 2014)
7. (a) Explain the orbital perturbations in detail. (8) (NOV/DEC 2014)
   (b) Explain the geometry for determining the sub satellite point with a diagram. (8) (NOV/DEC 2014)
8. (a)Describe the method of finding the position vector R of the Earth relative to the IJK frame. (08) (May/June 2013)
   (b) Calculate the magnitude of the position vector in the PQW frame for the orbit with $\Omega = 300°$, $\omega=60°$,$i=65°$, rp = -6500 km and rq=4000Km. Calculate also the position vector in the IJK frame and its magnitude. Confirm the magnitude. Confirm the magnitude of r vector unchanged in both frames.(8) (May/June 2013)(April/May 2015)
9. Explain in detail about geocentric-equatorial coordinate system which is based on the earth's equatorial plane. (16)
10. Explain in detail about topocentric-horizon coordinate system which is based on the observer's horizon plane. (16)
11. What is meant by polar orbiting and explain in details. (16)
12. State Kepler's three laws of planetary motion. Illustrate in each case their relevance to artificial satellites orbiting the earth. (16)
13. What are look angles? Explain how look angles are determined using sub satellite pints? Derive the necessary expression for look angles. (16)
14. Give a detailed note on launching vehicles and the procedures employed for launching spacecraft in GEO orbits. (16)

## UNIT – 2
## SPACE SEGMENT
## PART A

**1.What is a propellant? (April / May 2015)**

- Propellant is the chemical mixture burned to produce thrust in rockets and consists of a fuel and an oxidizer.
- A fuel is a substance that burns when combined with oxygen producing gas for propulsion. An oxidizer is an agent that releases oxygen for combination with a fuel.
- The ratio of oxidizer to fuel is called the mixture ratio. Propellants are classified according to their state - liquid, solid, or hybrid.

**2. What is meant by station keeping? (Nov/Dec2015)**

- It is the process of maintenance of satellite's attitude against different factors that can cause drift with time.
- Satellites need to have their orbits adjusted from time to time because the satellite initially placed in the correct orbit, natural forces induce a progressive drift.
- There are two types of station keeping
    1. East – West station keeping : this is the correction along the axis.
    2. North – South Station Keeping : this is to correct the change in inclination.

**3. What are geostationary satellites? (Nov/Dec2015)**

- A geostationary orbit is one in which a satellite orbits the earth at exactly the same speed as the earth turns and at the same latitude, specifically zero, the latitude of the equator.
- A satellite orbiting in a geostationary orbit appears to be hovering in the same spot in the sky, and is directly over the same patch of ground at all times.
- A Geo Stationary satellite is one which has a visible period of 23 h, 56 min, 4s, or 86,164s. The reciprocal of this is 1.00273896 rev/day.

**4. Define Roll, Pitch and Yaw. (May /June 2014)**

- The three axes which define a satellite's attitude are its roll, pitch, and yaw (RPY) axes All three axes pass through the center of gravity of the satellite.
- For an equatorial orbit, movement of the satellite about the roll axis moves the antenna footprint north and south; movement about the pitch axis moves the footprint east and west; and movement about the yaw axis rotates the antenna footprint.

**5. Define input back-off. (May /June 2014)**

- In order to reduce the inter modulation distortion, the operating point of the TWT must be shifted closer to the linear portion of the curve, the reduction in input power being referred to as i/p backoff.
- The saturation flux density for single carrier operation is known input backoff will be specified for multiple carrier operation, referred to the single carrier saturation level.
- The earth station EIRP will have to be reduced by the specified backoff (Bo), resulting in an uplink value of $[EIRP]_o = [EIRP_s]_u - [B_o]_i$

6. **Write down the parameters which are necessary for determining the look angles for the geostationary orbit. (Nov/Dec 2014)**
   - The coordinates to which the earth station antenna must be pointed to communicate with a satellite are called look angles.
   - The following parameters λE, ϕE, ϕss are necessary to determine the look angles.
   - The earth-station latitude, denoted here by λE
   - The earth-station longitude, denoted here by ϕE
   - The longitude of the sub satellitepoint, ϕss.

7. **Define sun transit outage. (Nov/Dec 2014)**
   - The event which must be allowed for during the equinoxes is the transit of the satellite between earth and sun, such that the sun comes within the beam width of the earth-station antenna.
   - When this happens, the sun appears as an extremely noisy source which completely blanks out the signal from the satellite.
   - This effect is termed sun transit outage, and it lasts for short periods—each day for about 6 days around the equinoxes.

8. **Distinguish between Geosynchronous and Geostationary orbits. (May/June 2013)**
   - Geosynchronous - An orbit around Earth whose orbital period is equal to a sidereal day (23 hours, 56 minutes), irrespective of its inclination.
     Ex: A person on a point on Earth, will see a satellite in this orbit in the same place in the sky at the same time of the day, every day.
   - Geostationary - A geosynchronous orbit around Earth at 35,786 km above the equator, so that it remains stationary as seen from Earth.
     Ex: A person on any point on Earth, will see a satellite in this orbit stationary w.r.t his position, just like a star in the sky.

9. **What are the needs for station keeping? (May/June 2013)**
   - Station-keeping maneuvers must be carried out to maintain the satellite within set limits of its nominal geostationary position.
   - There are a number of perturbing forces that cause an orbit to depart from the ideal keplerian orbit.
   - For the geostationary case, the most important of these are the gravitational fields of the moon and the sun, and the non-spherical shape of the earth, and also solar radiation pressure and reaction of the satellite itself to motor movement within the satellite.

10. **What is meant by payload?**
    - The payload refers to the equipment used to provide the service for which the satellite has been launched.
    - The payload comprises of a repeater and antenna subsystem and performs the primary function of communication
    - The repeater have two types 1.Transparent repeater 2. Regenerative Repeater.

11. **What is the temperature control in the satellite?**
    - The need for temperature control is to maintain a constant temperature inside the satellites. Because, the important consideration is that the satellites equipment should operate as nearly as possible in a stable temperature environment.

- Thermal blankets and shields may be used to provide insulation.
- Radiation mirrors are often used to remove heat from communication payload.
- These mirror drum surrounded the communication equipment shelves in each case and provide good radiation paths.

**12. Write notes on transponder.**

- A transponder is the series of interconnected units which forms a single communications channel between the receive and transmit antennas in a communications satellite
- It is a single communication channel which is formed by a series of interconnected units.
- A typical transponder bandwidth is 36 MHz, and allowing for a 4-MHz guard band between transponders, 12 such transponders can be accommodated in the 500-MHz bandwidth.

**13. Write short notes on attitude control system.**

- The attitude of a satellite refers to its orientation in space.
- Usually, the attitude-control process takes place aboard the satellite, but it is also possible for control signals to be transmitted from earth, based on attitude data obtained from the satellite.
- It is the system that achieves & maintains the required attitudes.
- The main functions of attitude control system include maintaining accurate satellite position throughout the life span of the system.

**14. Define angle of Tilt.**

- The angle a rocket makes with the vertical as it curves along its trajectory. The angle at which the dish is tilted relative to the polar mount until the bore sight is pointing at a satellite position due south of the earth station is known as angle of tilt. This is also referred as declination.

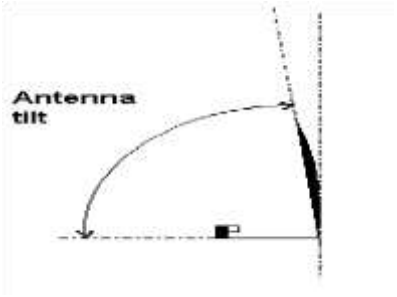


Fig: Tilt Angle

**15. Define Momentum Bias.**

- Spin stabilization may be achieved with cylindrical satellites.
- The satellite is constructed so that it is mechanically balanced about one particular axis and is then set spinning around this axis. For geostationary satellites, the spin axis is adjusted to be parallel to the N-S axis of the earth. In these dual-spin spacecraft, spin stabilization is obtained using spinning flywheels, which are termed as momentum wheels. The average momentum of these wheels is known as momentum bias.

## PART B

1. Explain about advanced Trios-N spacecraft and Morelos with a neat sketch. (16)(MAY /JUNE 2014) (APRIL/MAY 2015)
2. Explain in detail about antenna look angles and the polar mount antenna.(16) (MAY /JUNE 2014)(APRIL/MAY 2015)
3. Explain the procedure used to control the altitude control of satellite with necessary diagrams.(16) (NOV/DEC 2015)
4. (a) Determine the angle of tilt required for a polar mount used with an earth station at latitude 49° north. Assume a spherical earth of radius 6371 km, and ignore earth station altitude.(06) (NOV/DEC 2014)
   (b) Explain what is meant by satellite attitude, and briefly describe the attitude control with a relevant diagram.(10) (NOV/DEC 2014)
5. (a)Describe with a diagram, satellite eclipse and satellite sun transit around spring and autumn equinoxes.(10) (NOV/DEC 2014)
   (b) What is thermal control? Why it is necessary in a satellite? (6) (NOV/DEC 2014)
6. (a)An earth station is located at latitude 12°S and longitude 52° W. Calculate the antenna look angles for a satellite at 70°W.(8) (May/June 2013)
   (b) Show and explain the Earth eclipse of satellite . How this can be overcome by the satellites?(8)(May/June 2013)
7. Explain attitude control of satellites. With neat diagrams explain the spinning satellite stabilization and momentum wheel stabilization.(16) (May/June 2013)
8. (a)Explain transponders with necessary diagrams.(8)
   (b)Explain antenna subsystems with necessary diagrams.(8)
9. Explain what is meant by satellite attitude, and briefly describe two forms of attitude control. (16)
10. Draw the block diagram of TT&C and explain each and individual blocks. (16)
11. From the calculation of system noise temperature prove that C/N ratio is directly proportional to G/T ratio.(16)
12. List and explain the factors governing the design of satellite links. (16)
13. How is the performance of a satellite impaired due to external factors? Also suggest suitable methods to overcome the same. (16)
14. In detail, explain the various sub-modules and their functions of a Telemetry , Tracking and Command (TT & C) subsystem. Draw required diagrams. (16)
15. (a) With a neat sketch, explain the various modules of Attitude and orbit control(AOCS) subsystem. (16) (b)Derive the analytical expression for uplink CNR. (16)

## UNIT – 3
## SATELLITE LINK DESIGN
## PART A

1. **What are the effects of rain over space link? (Nov/Dec2015)**
   - In Ku band, rainfall is themost significant cause of signal fading.
   - Rainfall results in attenuation of radio waves by scattering and by absorption of energy from the wave.
   - Rain attenuation increases with increasing frequency and is worse in the Ku band compared with the C band.
   - The rain attenuation for horizontal polarization is considerably greater than for vertical polarization.

2. **Define fade margin. (Nov/Dec2015)**
   - The amount by which a received signal level may be reduced without causing system performance to fall below a specified threshold value.
   - It is mainly used to describe a communication system such as satellite, for example a system like global star operates at 25-35 dB Fade margin.
   - A design allowance that provides for sufficient system gain or sensitivity to accommodate expected fading, for the purpose of ensuring that the required quality of service is maintained.
   - The amount by which a received signal level may be reduced without causing system performance to fall below a specified threshold value.

3. **State the basic problems in satellite digital transmission. (April / May 2015)**
   The following are the basic problems occurs in satellite digital transmission,
   - No coverage of polar region, Long time delay, Echo, Eclipse due to the earth and the sun, Sun Transit outage

4. **What are Receiver Feeder losses? (May /June 2014)**
   - Losses at the connection of receiving antenna occurs at couplers, filters and waveguides. This is called receiver feeder loss (RFL). These Losses are added to free space loss (FSL) Similar losses occur at transmitting antenna.
   - Transmitter feeder losses are not accounted EIRP.

5. **What is the reason for placed LNA at the end of the feeder cable? (May /June 2014)**
   - A Low-noise amplifier (LNA) is an electronic amplifier that amplifies a very low-power signal without significantly degrading its signal-to-noise ratio.
   - An amplifier increases the power of both the signal and the noise present at its input
   - The receiving horn feeds into a low-noise converter (LNC) or possibly a combination unit consisting of a low-noise amplifier (LNA) followed by a converter.
   - Low noise amplifier(LNA) is placed at the end of the feeder cable so that the noise in the cable is reduced by the gain of the LNA.

6. **Expand TVRO and TT & C. (May /June 2014)**
   - **TVRO** : The earth segment of a satellite communications system consists of the transmit and receive earth stations. The simplest of these are the home TV receive-only (TVRO)

systems.

- TVRO systems relied on feeds being transmitted unencrypted and using open-standards, which heavily contrasts to DBS systems in the region.

**TT&C -** Tracking, Telemetry, and Command : Throughout the launch and acquisition phases, a network of ground stations, spread across the earth, is required to perform the tracking, telemetry, and command (TT&C) functions.

**7. A satellite downlink at 12GHz operates with a transmit powerof 60Wand an antenna gain of 48.2 dB. Calculate the ERP in dBW. (May /June 2014)**

**Given :**Downlink frequency = 12 Ghz

Transmit Power =60Watts

Antenna Gain =48.2 dB

**Calculation:**

EIRP = 10 log 6 + 48.2 = 56 dBW

**8. What are the basic requirements of an earth station antenna?**

- The basic requirements of an earth station antenna are listed below.
- The antenna must have a low noise temperature. The ohmic losses of antenna must also be maximum.
- The antenna must be rotated or steered easily so that a tracking system can be employed to point the antenna beam accurately.
- The antenna radiation must have a low side lobe level to reduce interference from unwanted signals and also to minimize interference into other satellites and terrestrial systems. The antenna must have a high directive gain.

**9. What is outdoor unit?**

- An outdoor unit consists of a receiving antenna feeding directly into a low-noise amplifier/converter combination.
- A parabolic reflector is generally used, with the receiving horn mounted at the focus.
- A common design is to have the focus directly in front of the reflector, but for better interference rejection an offset feed may be used.
- Comparing the gain of a 3-m dish at 4 GHz with a 1-m dish at 12 GHz, the ratio D/l equals 40 in each case, so the gains will be about equal.

**10. What is [C/N0] ratio for uplink?**

- The free-space and other losses are calculated for the uplink frequency.
- The resulting carrier-to-noise density is that which appears at the detector of the satellite receiver.

[C/N0]U=[ EIRP]U+[ G/T]U-[LOSSES]U-[K].

Uplink Satellite E/S Losses at Uplink frequencies

**11. Define output backoff.**

- An input backoff is employed, a corresponding output backoff must be allowed for the satellite EIRP.
- When the operating point of the Travelling wave tube amplifier (TWTA) is shifted closer to the linear portion in order to reduce intermodulation distortion.

- The corresponding drop in the output power in decibels is known as the output backoff.

**12. What is earth station of a satellite communications system?**

- The earth segment of a satellite communications system consists of the transmit and receive earth stations.
- The simplest of these are the home TV receive-only (TVRO) systems, and the most complex are the terminal stations used for international communications networks.
  Also included in the earth segment are those stations which are on ships at sea, and commercial and military land and aeronautical mobile stations.

**13. What is LNB?**

- The appropriate receiving device at the antenna is called a low-noise block converter (LNB), which contains a low-noise amplifier and a block down converter.
- On the transmit side, there would need to be an up converter and high power amplifier; if the transmit power required is less than about 10W, then it is
  possible to obtain both functions within what is called a block-upconverter (BUC).(or)
- The receiving horn feeds into a low-noise converter (LNC) or possibly a combination unit consisting of a low-noise amplifier (LNA) followed by a converter.
- The combination is referred to as an LNB, for low-noise block.

**14. Define Equivalent Isotropic Radiated Power.**

- A key parameter in link-budget calculations is the equivalent isotropic radiated power(EIRP).
- The maximum flux density at distance r from the transmitting antenna ofgin G
- An isotropic radiator with an input power equal to GPs would produce same flux density.

  Hence EIRP = GPs

  [EIRP]=[Ps]+[G] Dbw

**15. Define Antenna misalignment losses**

- When a satellite link is established, the ideal situation is to have the earth station and satellite antennas aligned for maximum gain.
- There are two possible sources of off-axis loss, one at the satellite and one at the earth station.
- The off-axis loss at the satellite is taken into account by designing the link for operation on the actual satellite antenna contour.
- The off-axis loss at the earth station is referred to as the antenna pointing loss.

**16. Write down the Link-Power Budget Equation**

- The [EIRP] can be considered as the input power to a transmission link.
- The major source of loss in any ground-satellite link is the free-space spreading loss [FSL], the basic link-power budget equation taking into account this loss only.
- The losses for clear-sky conditions are
  **[LOSSES]=[FSL]+[RFL]+[AML]+[AA]+[PL]**
- The power at the receiver may be calculated as
  **[PR]=[EIRP]-[LOSSES]+[GR],** where the last quantity is the receiver antenna gain.

**17. What is [C/N0] ratio for downlink?**

- The free-space and other losses are calculated for the downlink frequency.
- The resulting carrier-to-noise density is that which appears at the detector of the earth station receiver. [C/N0]D=[ EIRP]D+[ G/T]D-[LOSSES]D-[K]-[B].

Down Link Satellite E/S Losses at downlink frequencies

**18. What do you meant by rain attenuation?**

- Rain attenuation makes no sense to determine the attenuation caused by rainfall because they will be very punctual events,
- Since rain only causes severe attenuation in situations of heavy rain.
- Thus, even though one satellite transmission may be strongly affected due to rain, its orbit period of nearly 90 minutes minimizes that loss because the same ground station will have several other opportunities to receive VORSat's signals.
- For GEO satellites it becomes mandatory to perform these calculations, once the satellite's position in relation to the GS is permanent.

**19. What are the advantages of large antenna system?**

The advantages are

- Large antennas are capable of carrying large volume of traffic is its operation can be with wideband carriers.
- Large antenna produce narrow beams and large antenna can be easily equipped with automatic tracking system.
- It is possible to achieve the highest possible aperture efficiency and lowest possible noise temperature so that G/T is maximized in large antenna.
- Gain of the large antenna is high since effective aperture area is high and so aperture efficiency is also high.

**20. List the corrections added to received power for additional losses.**

- Corrections must be added to $P_R$ for additional losses due to Antenna efficiency – power is lost in the antenna feed structure, also connections to the receiver.
- Atmospheric absorption due to water and oxygen molecules
- Polarization mismatches of Tx & Rx antennas. Antenna misalignments –ie . bore sights of Tx and Rx antennas not aligned.

**21. Examine why noise temperature is a useful concept in communication receivers?**

Noise temperature is a measure of the noise entering a receiver through antenna. Noise temperature provides a way of determining how much thermal noise is generated by active and passive devices in the receiving system.

Generally, at the receiver side, the noise temperature should be maintained as low as possible. Front-end amplifier is immersed in liquid helium to maintain its physical temperature around $4^oK$. it is practical in large earth stations.

**22. Define output backoff.**

- An input backoff is employed, a corresponding output backoff must be allowed for the satellite EIRP.

- When the operating point of the Travelling wave tube amplifier (TWTA) is shifted closer to the linear portion in order to reduce intermodulation distortion.
- The corresponding drop in the output power in decibels is known as the output backoff.

**23. Write the equations of Link-Power Budget.**

- The power output of the link is power at the receiver.
- The major source of loss in any ground satellite link is the free space spreading loss.

[PR] = [EIRP] + [GR] – [LOSSES]

[LOSSES]=[FSL]+[RFL]+[AML]+[AA]+[PL]

Where, FSL=Free Space Spreading Loss(dB) RFL=Receiver Feeder Loss(dB)
AML=Antenna Misalignment Loss(sB); AA= Atmospheric Absorption(dB)
PL= Polarization mismatch Law(dB)

**24.What is system noise?**

- Noise temperature is very important concept in receivers. By using this, thermal noise which is generated by active and passive devices in the receiver can be calculated.
- The noise power is given by, Pn=KTnB
  Where, Pn=Noise power , K=Boltzman's constant
  Tn=Noise temperature of source(in Kelvin) B=Bandwidth in Hz

**25.Define noise factor.**

- An alternative way of representing amplifier noise is by means of its noise factor F.
- For defining it, the source is taken at room temperature, denoted by $T_0$.
- The input noise from such a source is KT0 and the output noise from the amplifier is $N_{0,out} = FGKT_0$ Where G -is the available power gain of the amplifier, F - is the noise factor

## PART B

1. (a)A satellite TV signal occupies the full transponder bandwidth of 86MHz, and it must provide a C/N ratio of 62dB at the destination earth station. Given that the total transmission losses are 600dB and the destination earth station G/T ration is 81dB/K. calculate the satellite EIRP required.(8) (MAY /JUNE 2014) (Nov/Dec2015)
   (b)Explain about Master Antenna TV system in detail.(8) (MAY /JUNE 2014) (Nov/Dec2015) 2. With the aid of block schematic, describe the functioning of the receive only home TV systems.
   (8)(Nov/Dec2015)
3. (a)Explain briefly CATV system. (8) (NOV/DEC 2014)
   (b)Discuss about antenna misalignment losses and feeder losses(8) (NOV/DEC 2014)
4. (a)Derive the link - Power budget equation. (8) (NOV/DEC 2014)
   (b) An LNA is connected to a receiver which has a noise figure of 12 dB. The gain of the LNA is 40dB, and its noise temperature is 120K. Calculate the overall noise temperature referred to the LNA input. (4) (NOV/DEC 2014)

   (c) A satellite is operated at an EIRP of 56dBW with an output BO of 6dB. The transmitter feeder losses amount to 2dB, and the antenna gain is 50dB. Calculate the power output of the TWTA required for full saturated EIRP. (4) (NOV/DEC 2014)
5. (a)Draw the detailed block diagram of a transmit receive earth station and explain.

(8)(May/June 2013)

(b)Describe and compare MATV and CATV systems.(8) (May/June 2013)

6. (a)Derive expression for the link power budget of a satellite system.(8)(May/June 2013)
   (b)What is saturation flux density? If the power received by a 1.8 m parabolic antenna at 14 GHz is
   250pW, then calculate the saturation flux density. (8)(May/June 2013)
7. (a)With the aid of a block schematic, briefly describe the functioning of the receive only home TV systems. (8)(MAY /JUNE 2014)
   (b)An antenna has noise temperature of 100 K and is matched into a receiver which has a noise temperature of 400K. Calculate the noise power density and the noise power for a bandwidth of 80MHz.(8) (MAY /JUNE 2014)(Nov / Dec 2015)
8. Draw the block diagram and explain the receive only home TV system.(16) (APRIL /MAY 2015)
9. Explain the following. (APRIL /MAY 2015)
   (I) EIRP. (8)
   (II)Transmission Losses.(8)
10. With a neat diagram, explain the procedure for measuring critical satellite parameters like C/N0 and G/T. Emphasize on the significance of these parameters. (16)
11. In detail explain the block diagram representation of a typical digital earth station(Transmitter and receiver).Give the block diagram.(16)
12. With a neat sketch, Explain the power budget for a link considering backoff and rain fade margin.
13. How does the system noise temperature affect the performance? Derive the expression for overall system noise temperature at the receiving earth station.
14. With a neat diagram how measurements on G/T and C/N0 are made (16)
15. Give a detailed note on
    (a) TVRO
    (b) MATV Earth station antennas. (16)

## UNIT – 4
## SATELLITE ACCESSAND CODING METHODS
## PART A

**1. List the advantages of CDMA, especially where VAST type terminals are involved. (May/June 2013) April/May 2015**

The advantages of CDMA are

- Efficient practical utilization of fixed frequency spectrum.
- Flexible allocation of resources.
- Many users of CDMA use the same frequency, TDD or FDD may be used
- Multipath fading may be substantially reduced because of large signal bandwidth
- No absolute limit on the number of users, Easy addition of more users.
- Impossible for hackers to decipher the code sent
- No sense of handoff when changing cells
- CDMA is compatible with other cellular technologies; this allows for nationwide roaming.

The combination of digital and spread-spectrum modes supports several times as many signals per unit bandwidth as analog modes.

**2. Write about demand assigned TDMA satellite access. (Nov /Dec 2015)**

- Resource isallocated as needed in response to changing traffic conditions.
- Suitable for bursty or varying traffic conditions.
- More number of earth stations can access the satellite.
- Efficient resource utilization.
- The burst length may be kept constant and the number of bursts per frame used by the given station is varied when the demand is varied.

**3. What is meant by thin route service? (May/June 2013) (April/May 2015)**

- Trafficcan be broadly classified as heavy route, medium route, and thin route.
- In a thin-route circuit, a transponder channel (36 MHz) may be occupied by a number of single carriers, each associated with its own voice circuit.
- This mode of operation is known as single carrier per channel (SCPC).

**4. Define CDMA. (May /June 2014)**

- In this method, each signal is associated with a particular code that is used to spread the signal in frequency & or time.
- Spread spectrum multiple access
- Pulse address multiple access

**5. Define the term preamble and post amble. (May /June 2014) (Nov /Dec 2015)**

- Preamble is the initial position of a traffic burst which carries information similar to that carried in
- Certain time slots at the beginning of each burst are used to carry timing & synchronizing information.
- These time slots collectively are referred to as preamble.

**6. What is a single access?**

- A single access means, single modulated carries occupies the whole of the available bandwidth of a transponder.
- Single access operation is used only on heavy traffic routers.
- Example : Telesat Canada - in this satellite each transponder channel being capable of carrying 960 one way voice circuits on an FDM/FM carrier and so it provides heavy route message facilities.

**7. What are the disadvantages of FDMA.**

The following are the dis advantages of FDMA

- Sensitive to fading
- Stabilization is difficult.
- Sensitive to random frequency modulation.
- Sensitive to inter modulation distortion.

**8. What is meant by multiple access?**

- A transponder to be loaded by a number of carriers, which may originate from a number of earth stations geographically separate and each earth station may transmit one or more of the carriers.
- This is called as multiple access.
- There are different multiple access techniques they are

  FDMA : Frequency Division Multiple Access
  TDMA: Time Division Multiple Access
  CDMA: Code Division Multiple Access

**9. What is CBR?**

- An un modulated carrier wave is provided during the first part of the carrier and bit-timing recover (CBR) time slot.
- It is used as a synchronizing signal for local oscillator in the detector circuit.
- In theremaining part of CBR time slot, the carrier is modulated by a known phase change sequence.

**10. What is BCW?**

- The copy of burst code word (BCW) is stored in all the earth stations. Incoming bits in the burst are compared with the BCW.
- The receiver detects the group of received bits matched with BCW. Then, accurate time reference for the burst position in frame is provided.

**11. What is amplitude modulation?**

- The modulated signal may be expressed as,

  $$am(t)=\{kas(t)+1\}Ac \sin(\omega ct+ 1 )$$

- For special case where the modulating signal in sine wave with angular frequency cos and letting k=m,above equation becomes $am(t)=(m\sin\omega st+1)Ac \sin \omega ct$ where, m=modulation index.

**12. What is meant by space division multiple access?**

- The satellite as a whole to be accessed by earth stations widely separated geographically but transmitting on the same frequency i.e. known as frequency reuse.
- This method of access known as space division multiple access.

**13. What is burst code word and burst position acquisition?**

- Burst code: It is a binary word, a copy of which is stored at each earth station. Burst position acquisition:
- A station just entering, or reentering after a long delay to acquire its correct slot position is known as burst position acquisition.

**14. Define guard time.**

- It is necessary to prevent the bursts from overlapping.
- The guard time will vary from burst to burst depending on the accuracy with which the various bursts can be positioned within each frame.

**15. What are the limitations of FDMA-satellite access**?

- If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient.
- So, bandwidth of the uplink channel is not fully used.
- Compared with TDMA, FDMA has less flexibility in reassigning channels.
- Carrier frequency assignments are hardware controlled.

**16. What is meant by decoding quenching?**

- In certain phase detection systems the phase detector must be allowed time to recover from one burst before the next burst is received by it.
- This is known as decoding quenching.

**17. What is meant by digital speech interpolation?**

- The point is that for a significant fraction of the time the channel is available for other transmissions,& advantages is taken of this in a form of demand assignment known as digital speech interpolation.

**Types**

- Digital time assignment speech interpolation
- Speech predictive encoded communications

**18. Write short notes on open-loop timing control.**

- It is a method of transmit timing. In this method, according to burst time plan, a station transmits at a fixed interval.
- Necessary guard time is allowed to absorb the variations in propagation delay.

**19. What is meant by burst position acquisition & burst position synchronization?**

- Burst position acquisition & burst position synchronization means when a station just entering, or reentering after a long delay to acquire its correct slot position.

**20. Point out the pre-assigned TDMA satellite access.**

Example for preassigned TDMA is CSC for the SPADE network. CSC can accommodate upto 49 earth stations in the network and 1 reference station. All bursts are of equal length. Each burst contains 128 bots. The bit rate is 128 Kb/s.

**21. How does the spread spectrum system differ from conventional communicational communication systems?**

The spread spectrum system undergo double modulation.

1. First modulation – carrier and message signal.
2. Second modulation – the resultant signal and PN code sequence, which spreads the spectrum over the available bandwidth.

## PART B

1. (a)Discuss satellite links and TCP.(8) (APRIL /MAY 2015)
   (b)Explain direct sequence spread spectrum.(8) (APRIL /MAY 2015)
2. (a)With neat diagrams, explain the TDMA burst and frame structure of satellite system.(12) (APRIL/MAY 2015)
   (b)Compare FDMA, TDMA, and CDMA. (4) (APRIL /MAY 2015)
3. (a)What is a SPADE system? Explain its channeling scheme and operation. (May/June 2013)(8)(Nov/Dec2015)
   (b)Explain pre assigned TDMA and Demand assigned TDMA in detail. (May/June 2013)(8) (Nov/Dec2015)
4. (a)Describe the conventional approach and group signal processing of on-board signal processing for FDMA/TDM operation.(8) (May/June 2013) (Nov/Dec2015)
   (b)Describe how signal acquisition and tracking are achieved in a DS/SS system. (8)(May/June 2013) (Nov/Dec2015)
5. (a)Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system. Also determine the throughput efficiency of the system. (10) (MAY /JUNE 2014)
   (b)Write short notes on satellite links and TCP.(6) (MAY /JUNE 2014)
6. Describe briefly about on board signal processing for FDMA/TDMA operation.(16) (MAY /JUNE2014)
7. Explain clearly the pre assigned FDMA with suitable diagrams and show how it differs from demand assigned FDMA. (16) (NOV/DEC 2014)
8. Draw the frame and burst format of TDMA and explain the need for a reference burst in a TDMA system.(16) (NOV/DEC 2014)
9. With a neat block diagram, explain the functioning of a SPADE System.(16)
10. Describe the ways in which demand assignment may be carried out in FDMA. (16)
11. Explain the following 1. pre assigned Traffic. 2. Encryption. (16)
12. For digital video broadcast what type of multiple access is best suited. Justify your answer. (16)
13. With a neat block diagram explain the working of a FDMA based satellite network. Analyse its merits and demerits.
14. In detail explain the format structure of TDMA frame. Comment on the significance of each field 15. Explain the concept of compression in satellite links.

## UNIT – 5
## SATELLITE APPLICATIONS
## PART A

1. **List the types of maps. (May/June 2013) Types of map:**
   - Topographic map - a reference tool, showing the outlines of selected natural and man-made features of the Earth it acts as a frame for other information.
   - Topography" refers to the shape of the surface, represented by contours and/or shading, but topographic maps also show roads and other prominent features.
   - Thematic map - a tool to communicate geographical concepts such as the distribution of population densities, climate, movement of goods, land use etc.

2. **How many satellites are in the space for providing GPS data? (May/June 2013)**
   Thereare 4 satellites are needed to cover entire earth.

3. **What are the components of GIS? (May /June 2014) (Nov/Dec 2014) (April / May 2015)**
   The three components of a Geographical Information System are
   - Computer hardware, Software Modules, Organizational context.

4. **What are the services(Applications) of GPS? (May /June 2014)**
   Some important services of Global Positioning System (GPS) are
   - Aircraft tracking
   - Map making
   - Surveying
   - Search and rescue.
   - Missile and projectile guidance.

5. **Write the main components of GPS.**
   - The Control segments, The Space segments, The User segments

6. **What is map?**
   - A map is defined as the representation of the features of the earth drawn to scale.
     - It is the traditional method of storing, analyzing and presenting spatial data.
   - The map is also known as the ‘spatial language’.

7. **Write about Gramsat?**
   - The Gramsat Programme (GP) is an initiative to provide communication networks at the state level connecting the state capital to districts and blocks.
   - The networks provide Computer Connectivity, Data Broadcasting and TV Broadcasting facilities having applications like e-Governance, National Resource Information System (NRIS),
     Development Information, Tele-conferencing, Disaster Management, Tele-medicine and Distance Education.

8. **Define DTH.**
   - DTH stands for Direct-To-Home television.
   - DTH is defined as the reception of satellite programmes with a personal dish in an individual home.

**9. What are the components of DTH.**

- A DTH network consists of a broadcasting centre,
- Satellites,
- Encoders,
- Multiplexers,
- Modulators and DTH receivers.

**10. What do you meant by video conferencing?**

- A videoconference is a live connection between people in separate locations for the purpose of communication, usually involving audio and often text as well as video.
- At its simplest, videoconferencing provides transmission of static images and text between two locations. At its most sophisticated, it provides transmission of full-motion video images and highquality audio between multiple locations.

**11. What do you mean by DBS.**

- Direct broadcast satellite (DBS) refers to satellite television (TV) systems in which the subscribers, or end users, receive signals directly from geostationary satellites.
- Signals are broadcast in digital format at microwave frequencies. DBS is the descendant of directto-home (DTH) satellite services.

**12. What do you meant by DAB.**

- Digital audio broadcasting (DAB), also known as digital radio and high-definition radio, is audio broadcasting in which analog audio is converted into a digital signal and transmitted on an assigned channel in the AM or (more usually) FM frequency range.
- DAB is said to offer compact disc (CD)- quality audio on the FM (frequency modulation) broadcast band and to offer FM-quality audio on the AM (amplitude modulation) broadcast band.

**13. Define LEO ?**

- LEO means Low Earth Orbit it is relatively low in altitude;
- The altitude range is between 200 and 1200 km above the Earth's surface.

**14. Give the Applications of LEO?**

- Communications satellites - some communications satellites including the Iridium phone system use LEO.
- Earth monitoring satellites – it use LEO as they are able to see the surface of the Earth more clearly as they are not so far away. They are also able to traverse the surface of the Earth.
- The International Space Station : It is in an LEO that varies between 320 km (199 miles) and 400 km (249 miles) above the Earth's surface. It can often be seen from the Earth's surface with the naked eye.

**15. Define MEO.**

- A medium earth orbit (MEO) satellite is one with an orbit within the range from a few hundred miles to a few thousand miles above the earth's surface.
- Satellites of this type orbit higher than low earth orbit (LEO) satellites, but lower than geostationary satellites.

**16. Compare LEO,MEO and GEO**

| Parameter | LEO | MEO | GEO |
|---|---|---|---|
| Satellite Height | 500-1500 km | 5000-12000 | 35,800 km |
| Orbital Period | 10-40minutes | 2-8 hours | 24 hours |
| Number of | 40-80 | 8-20 | 3 |
| Satellite Life | Short | Long | Long |
| Number of | High | Low | Least(none) |
| Cost | Cheap | Very Expensive | Expensive |
| Propagation Loss | Least | High | Highest |

**17. What are the INSAT services?**

The INSAT provides 3 main services

- Long distancecommunication
- TV and Radio broadcasting.
- Metrology.

**18. What are the services and features of GSM?**

The GSM services are classified into 2.

- Tele services.
- Data services.

Features of GSM:

- Subscriber Identity Module (SIM)
- On the air privacy.

**19. Define Satellite Navigational System.**

- Satellite Navigation are SATNAV system is a system of satellite that provides autonomous geospatial positioning with global coverage.
- It allows electronic receivers to determine the latitude, longitude and attitude position within a few meters using timing signals transmitted from a line of sight by radio from the satellite.

**20. What do you infer about GRAMSAT?**

ISRO has come up with the concept of dedicated GRAMSAT satellites, keeping in mind the urgent need to eradicate illiteracy in the rural belt which is necessary for the all round development of the nation.

This GRAMSAT satellite is carrying six to eight high powered C-band transponders, which together with video compression techniques can disseminate regional and cultural specific audio-visual programmes of relevance in each of the regional languages through rebroadcast mode on an ordinary TV set.

**22. Write the features of MATV.**

A master antenna TV MATV system includes,

- Provide reception of direct broadcast system (DBS) TV/FM channels to a small group of users.
- Single outdoor unit is needed, but feeds number of indoor units.
- Each receiver has access to all the independent channels of other users.

**23. Outline the three regions to collect the frequency for satellite services.**

- Region 1: It covers Europe, Africa and Mangolia
- Region 2: It covers North & south America and Greenland
- Region 3: It coversAsia, Australia and South west pacific

## PART B

1. List the characteristics of digital satellite image and explain how image enhancement is carried out. (16) (APRIL /MAY 2015)
2. Explain the types of maps used in GIS based urban applications. (16)(APRIL /MAY 2015)
3. Explain the data input hardware of GIS. (16)(Nov/Dec2015)
4. Explain the following satellite applications (16)(Nov/Dec2015)
   (a)Global positioning system. (6) (b) Satellite navigation system. (10)
5. Explain in detail about Integration of GIS, remote sensing and urban application. (16)(MAY /JUNE 2014)
6. (a)Explain in detail about elements of interpretation and Interpretation keys characteristics of digital satellite image. (10) (MAY /JUNE 2014)
   (b)With short notes on Resource information system. (6) (MAY /JUNE 2014)
7. (a)Discuss about the key characteristics of digital satellite image. (8) (NOV/DEC 2014)
   (b)Write short notes on types of maps. (8) (NOV/DEC 2014)
8. (a)Explain what is meant by remote sensing and also the need of integration of GIS and remote sensing.(12) (NOV/DEC 2014)
   (b)State the advantages of GPS. (4) (NOV/DEC 2014)
9. (a)Describe the visual interpretation of satellite images. What are the elements of interpretation? Explain it.(8) (May/June 2013)
   (b)Explain the various image enhancement schemes. (8) (May/June 2013)
10. (a)Explain the significance of integrating GIS and remote sensing. What are their application? (8) (May/June2013)
    (b)Write a detailed note on GPS and its application in GIS. (8) (May/June 2013)
11. Explain with neat diagram about DTH system (16)
12. Write short notes on (16)

    **(a)** Gramsat (b)E mail Service
13. Write short notes on the specialized services offered by satellites for video conferencing e-mail and internet. (16)
14. In detail explain the various mobile satellite services and their impact on society. (16)
15. In detail Explain about INMARSAT, LEO, MEO. (16)

Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : X10347

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
AND APRIL/MAY 2021
Fifth/Seventh/Eighth Semester
Geoinformatics Engineering
EC 8094 – SATELLITE COMMUNICATION
(Common to Electronics and Telecommunication Engineering, Electronics and Communication Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. A satellite is in an elliptical orbit with eccentricity of 0.6 and perigee altitude 1000 Km. Determine :
   a) The semi major axis
   b) The period of revolution
2. Assume a circular orbit : Using Newton's law of gravitation and Newton's second law, determine the acceleration of a satellite.
3. Define payload and transponder.
4. Draw the block diagram of antenna subsystem.
5. Explain what is meant by noise factor.
6. Calculate the effective area of a 10-ft parabolic reflector antenna at a frequency of (a) 4 GHz (b) 12 GHz.
7. Explain the need for a reference burst in a TDMA system.
8. What is the use of control bits in the data frame ?
9. What is the difference between active and passive satellites ?
10. What does the acronym VSAT stand for ?

PART – B (5×13=65 Marks)

11. a) Derive the complete expression for Look Angles, along with intermediate angle in satellite communication. Show that intermediate angle is : (13)

$$\alpha = \tan^{-1}\left(\frac{\tan|l_s - l_e|}{\sin(L_e)}\right)$$

(OR)

b) i) A satellite is in a circular orbit around the earth. The altitude of the satellite's orbit above the surface of the earth is 1400 Km.

i) What are the centripetal and centrifugal accelerations acting on the satellite in its orbit ? Give your answer in $m/s^2$.

ii) What is the velocity of the satellite in this orbit ? Give your answer in km/s.

iii) What is the orbital period of the satellite in this orbit ? Give your answer in hours, minutes and seconds. (10)

ii) Differentiate between Geosynchronous and Geostationary orbits. (3)

12. a) i) Define and explain the terms roll, pitch and yaw. (3)

ii) Describe the tracking, telemetry and command facilities of a satellite communications system. Are these facilities part of the space segment or part of the ground segment of the system ? (10)

(OR)

b) i) Explain Spin Stabilization and Three-axis Stabilization. (5)

ii) Explain what is meant by thermal control and why this is necessary in a satellite. (4)

iii) Explain what is meant by satellite attitude and briefly describe two forms of attitude control. (4)

13. a) i) A certain 6/4 GHz satellite uplink has earth station EIRP is 80 dBW; Earth station satellite distance is 35780 Km; attenuation due to atmospheric factors is 2 dB; satellite antennas aperture efficiency is 0.8; satellite antennas aperture area is 0.5 $m^2$; satellite receivers effective noise temperature is 190 K; satellite receivers bandwidth is 20 MHz. Determine the link margin for satisfactory quality of service if the threshold value of received carrier to noise ratio is 25 dB. (8)

ii) A geostationary satellite transmits 5 W of power with an antenna having a gain of 28 dB. The downlink is operated at 4 GHz and the receive antenna is a dish with diameter of 3.6 m. Compute the EIRP transmitted and the power received by the receiving antenna. Assume the receiver antenna efficiency to be 0.7 and all the other losses to be 2 dB. **(5)**

(OR)

b) i) Explain what is meant by saturation flux density. The power received by a 1.8 m parabolic antenna at 14 GHz is 250 pW. Calculate the power flux density (a) in $W/m^2$ and (b) in $dBW/m^2$ at the antenna. **(5)**

ii) Explain what is meant by input backoff. An earth station is required to operate at an [EIRP] of 44 dBW in order to produce saturation of the satellite transponder. If the transponder has to be operated in a 10 dB backoff mode, calculate the new value of [EIRP] required. **(5)**

iii) Two amplifiers are connected in cascade, each having a gain of 10 dB and a noise temperature of 200 K. Calculate (a) the overall gain and (b) the effective noise temperature referred to input. **(3)**

14. a) i) Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network. **(7)**

ii) Given that the IF bandwidth for a 252-channel FM/FDM telephony carrier is 7.52 MHz and that the required [C/N] ratio at the earth station receiver is 13 dB, calculate (a) the [C/T] ratio and (b) the satellite [EIRP] required if the total losses amount to 200 dB and the earth station [G/T] ratio is 37.5 dB/K. **(6)**

(OR)

b) i) Briefly describe the ways in which demand assignment may be carried out in an FDMA network. **(5)**

ii) What is the function of :

a) the burst-code word and

b) the carrier and bit-timing recovery channel in a TDMA burst ? **(4)**

iii) In a TDMA network the reference burst and the Preamble each requires 560 bits, and the nominal guard interval between bursts is equivalent to 120 bits. Given that there are eight traffic bursts and one reference burst per frame and the total frame length is equivalent to 40, 800 bits, calculate the frame efficiency. **(4)**

15. a) i) Explain the characteristics of a typical VSAT system and Key Components for a VSAT network. (8)

ii) Compare LEO and MEO satellite. What are the advantage, disadvantage and application of LEO and MEO satellite ? (5)

(OR)

b) i) Explain the working of Global Positioning System. (8)

ii) Explain the working of Direct Broadcast Satellites in detail. (5)

PART – C (1×15=15 Marks)

16. a) Consider a (6, 3) linear block code defined by the generator matrix. (15)

$$\vec{G} = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

1) Find the encoding table for the linear block code.

2) Draw the hardware encoder diagram.

3) Suppose is $\vec{c} = [111000]$ is sent and $\vec{r} = [111001]$ is received. Show how the code can correct this error.

(OR)

b) i) The state of Virginia may be represented roughly as a rectangle bounded by 39.5° N latitude on the north, 36.5° N latitude on the south, 76.0° W longitude on the east and 86.3° W longitude on the west. If a geostationary satellite must be visible throughout virginia at an elevation angle no lower than 20°, what is the range of longitudes within which the sub-satellite point of the satellite must lie ? (10)

ii) A ground station lies at latitude = 39.2906 degrees N and longitude = 280.2629 degrees E. A Geostationary satellite at radius r = 42164 km has a longitude of 280.2629 degrees E. Calculate the range and look angles (azimuth and elevation angles) to the satellite. (5)

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Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : 21293

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Eighth Semester

Electronics and Communication Engineering

080290077 – SATELLITE COMMUNICATION

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the various types of satellite orbits.
2. Define the term 'azimuth'.
3. Mention the various mechanisms through which attitude control is attained.
4. What are transponders?
5. List out the types of modulation schemes employed in satellite communication.
6. Define the term 'beam switching'.
7. Give the significance of EIRP.
8. Define the term 'antenna gain'.
9. What are satellite phones?
10. What is meant by DAB? Give its significance.

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are orbital elements? How are they helpful in locating satellites in orbital planes? (10)

(ii) Explain the launching procedure of geo-stationary satellites using launch vehicles. Give diagrams. (6)

Or

(b) State and derive the expressions for the look angles. Give necessary diagrams. (16)

12. (a) Explain how attitude control is established through various satellite stabilization techniques. (16)

Or

(b) Deduce the expression for overall carrier to noise ratio starting from received power flux. Indicate the power margin assigned to accommodate various losses excluding atmospheric losses. (16)

13. (a) With a neat block diagram, explain the working of a FDMA based satellite network. Analyse its merits and demerits. (16)

Or

(b) (i) In detail, explain the format structure of TDMA frame. Comment on the significance of each field. (10)

(ii) Explain satellite switched TDMA. (6)

14. (a) Give a detailed note on

(i) TVRO (5)

(ii) MATV (5)

(iii) Earth station antennas. (6)

Or

(b) With neat diagrams, explain how measurements on $\frac{G}{T}$ and $\frac{C}{N_0}$ are made. (16)

15. (a) In detail, explain the various mobile satellite services and their impact on society. (16)

Or

(b) Give a detailed note on

(i) DBS and DTH (8)

(ii) GRAMSAT and Business TV. (8)

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Reg. No. : | | | | | | | | | | | | |

**Question Paper Code : 21343**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Eighth Semester

Electronics and Communication Engineering

EC 2045/EC 810 -- SATELLITE COMMUNICATION

(Regulation 2008)

(Common to PTEC 2045 — Satellite Communication for B.E. (Part-Time) Seventh Semester - Electronics and Communication Engineering — Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given the geostationary orbital radius 'r', the Earth's radius 'R' and speed of light 'C' how will you compute the time taken for a signal to pass from Earth to the Satellite and back again?

2. ~~Enlist the traditional orbital Keplerian elements~~

3. How is the attitude of a satellite controlled through active control?

4. Why the operation near the saturation point of a TWTA is to be avoided when multiple carriers are being amplified simultaneously?

5. When VSAT-type terminals involved CDMA offers several advantages for satellite networking. What are they?

6. Point out the function of (a) the burst code word and (b) the carrier and bit-timing recovery channel in a TDMA burst.

7. Give the reason for deploying a demodulator/remodulator unit in our home television set when we want to function in a satellite TV/FM receiving system.

8. What is known as polarization interleaving with reference to the Down link frequency?

9. When the available bandwidth is 500 MHZ, how many transponder each of bandwidth 24 MHZ can be accomodated.

10. What is meant by conjestion and slowstart with reference to Internet traffic.

PART B — (5 × 16 = 80 marks)

11. (a) (i) A satellite is orbiting the equatorial plane with a period from perigee to perigee of 10h. Given that the eccentricity is 0.002 and the earth's equatorial radius is 6378.1414 km how will you calculate the semi major axis.

(ii) Summarise how you will determine the look angles for the geostationary orbit? What are known as sun-synchronous orbits.

Or

(b) (i) How will you determine the sub satellite point?

(ii) Write a brief note on launch vehicles and propulsion.

12. (a) How do the TT and C subsystem perform aboard the spacecraft? Also explain the working of a transponder unit.

Or

(b) How is the performance of a satellite impaired due to external factors? Also suggest suitable methods to overcome the same.

13. (a) (i) Describe the ways in which demand assignment may be carried out in FDMA.

(ii) What is known as pre-assigned traffic?

Or

(b) (i) Calculate the probability of false detection, when N = 10 and d = 4.

(ii) For digital video broadcast what type of multiple access is best suited. Justify your answer.

14. (a) Show how MATV is used to provide reception of DDS to a small group of users. When this group is large what type of antenna should be used? Explain.

Or

(b) Analyse the functioning of Transmit — Receive Earth stations. With a block diagram explain how the redundant earth station functions.

15. (a) Enumerate how GSM and GPS deploying Satellites have improved the mobility of the customers.

Or

(b) Write short notes on the specialized services offered by satellites for video conferencing e-mail and internet.

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Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : 51385

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2014.

Eighth Semester

Electronics and Communication Engineering

EC 2045/EC 810/10144 ECE 52 — SATELLITE COMMUNICATION

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define geostationary orbit.

2. What do you mean by apogee?

3. Why is noise temperature a useful concept in communication receivers?

4. Write the objectives with which the downlink of any satellite communication system must be designed.

5. Define multiplexing.

6. Write the two basic problems in satellite digital transmission.

7. For a given satellite and signal transmission, what are the earth station parameters affecting the C/N ratio?

8. Why is the cassegrain antenna popular for large earth stations?

9. Write the four kinds of communications that the network structure of MSAT can accommodate.

10. Write the two areas of satellite communications which are gaining major thrust from leading satellite industries and organisations in recent years.

PART B — (5 × 16 = 80 marks)

11. (a) Explain how Kepler's and Newton's laws are used to describe the orbit. (16)

Or

(b) Explain the following :

(i) Orbital perturbations. (8)

(ii) Launching vehicles. (8)

12. (a) From the calculation of system noise temperature prove that C/N ratio is directly proportional to G/T ratio. (16)

Or

(b) (i) List and explain the factors governing the design of satellite links. (10)

(ii) What are the factors contributing to noise in an earth station receiving channel? (6)

13. (a) Briefly discuss about analog voice transmission. (16)

Or

(b) Compare the salient features of FDMA, TDMA and CDMA. (16)

14. (a) Briefly explain about the test equipments for earth stations. (16)

Or

(b) (i) Briefly discuss on TVRO systems. (8)

(ii) Describe how the gain of large antennas can be optimized. (8)

15. (a) Explain the types of INTELSAT satellites with respect to basic space craft characteristics and vehicle type. (16)

Or

(b) (i) Explain the block diagram of an outdoor unit for a DBS home receiver. (8)

(ii) With a block schematic explain about DTH system. (8)

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Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : 91387

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Eighth Semester

Electronics and Communication Engineering

EC 2045/EC 810/10144 ECE 52 — SATELLITE COMMUNICATION

(Regulation 2008/2010)

(Common to PTEC 2045 – Satellite Communication for B.E. (Part-Time) Seventh Semester – ECE – Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the viewing angle of a geostationary satellite orbiting at 42200 km from an earth station making an elevation angle of 25°.
2. What is ascending node and descending node?
3. What is split body stabilization?
4. What is frequency planning
5. What are the advantages of TDMA over FDMA?
6. Define multiplexing.
7. Define antenna gain
8. A satellite downlink at 10GHZ operates with a transmit power of 5w and an antenna gain of 48.2dB.Calculate the EIRP in dBw.
9. List the differences between LEO and MEO satellites.
10. What is GRAMSAT?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Describe the steps involved in launching a satellite. (8)

(ii) What are the different types of satellite orbits? Discuss their merits and demerits. (8)

Or

(b) (i) Define look angle and explain look angle determination in detail. (8)

(ii) If a satellite is at a height of 36000 km and orbiting in equatorial plane, comment whether the satellite will be under eclipse on equinox days and find the duration of the eclipse. (8)

12. (a) (i) Explain how altitude and orbit control is achieved from an earth station. (8)

(ii) Derive the satellite link design equation. (8)

Or

(b) (i) Why T, T and C are necessary for a satellite system? Explain in detail. (8)

(ii) Briefly explain the sources of noise in satellite communication. What is the importance of noise temperature in link design? (8)

13. (a) (i) Explain FDMA in detail and also enumerate the interference in FDMA. (8)

(ii) Explain direct sequence spread spectrum communication in detail. (8)

Or

(b) (i) Explain what is meant by back off and why as it necessary in multiple access systems. (6)

(ii) Explain digital video broadcasting in detail (10)

14. (a) (i) Draw the block diagram and explain the TVRO system. (8)

(ii) Explain in detail the test equipment measurement on G/T, C/No. (8)

Or

(b) (i) Explain earth station transmitter and receiver with necessary block diagram. (10)

(ii) Explain CATV in detail with a neat diagram. (6)

15. (a) (i) Explain direct broadcast satellite in detail. (8)

(ii) Explain GPS in detail with necessary diagrams. (8)

Or

(b) Write notes on

(i) INTELSAT

(ii) E-mail

(iii) BTV

(iv) DTH.

Reg. No. : | | | | | | | | | | | |

# Question Paper Code : 71428

B.E./B.Tech DEGREE EXAMINATION, APRIL/MAY 2015.

Eighth Semester

Electronics and Communication Engineering

EC 2045/EC 810/10144 ECE 52 – SATELLITE COMMUNICATION

(Regulation 2008/2010)

(Common to PTEC 2045 – Satellite Communication for B.E. (Part-time)

Seventh Semester – ECE – Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer All questions.

PART - A (10 X 2 = 20 marks)

1. State Kepler's Second Law

2. Differentiate ascending node from descending node.

3. Why thermal control is necessary?

4. Which parameters decide the system reliability?

5. Define single access and multiple access.

6. What is the need of reference burst in TDMA?

7. What is the difference between DBS TV and conventional TV?

8. A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.

9. Name the services provided by GSM.

10. What are the features of LEO?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 h. Given that the eccentricity is 0.002. Calculate the semi major axis. The earth's equatorial radius is 6378.1414km.

(ii) Explain the orbital perturbations in detail.

Or

(b) (i) Determine the limits of visibility for an earth station situated at mean sea level, at latitude 48.42° north, and longitude 89.26 degrees west. Assume a minimum angle of elevation of 5°. (6)

(ii) Discuss about launching procedures. (10)

12. (a) (i) Explain TT and C system in detail. (8)

(ii) Derive the downlink C/N ratio for the satellite. (8)

or

(b) (i) Explain how intermodulation noise originates in a satellite link and describe how it is reduced? (8)

(ii) Derive link — power budget equation. (8)

13. (a) (i) Explain what is meant by FDMA, and show how this differs from FDM. (6)

(ii) Briefly describe the ways in which demand assignment may be carried out in FDMA network. (10)

Or

(b) Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system. (16)

14. (a) Describe and compare the MATV and the CATV systems. (16)

Or

(b) (i) Explain any one test equipment for the measurement on C/No. (8)

(ii) Draw the basic block of earth segment and explain

15. (a) (i) Explain the operation of VSAT system in detail. (8)

(ii) Describe the GPS functioning with a block diagram. (8)

Or

(b) (i) Explain how DTH operation is carried out with a neat diagram. (10)

(ii) Write a brief note on video conferencing. (6)

**Question Paper Code:80315**

**B.E/B.TECH. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016**

**SEVENTH SEMESTER**

**ELECTRONICS AND COMMUNICATIONENGINEERING**

**EC 6004-SATELLITE COMMUNICATION**

**(REGULATION 2013)**

**Time: Three hours** **Maximum: 100 marks**

**Answer ALLQuestions**

**PART A- (10x 2 = *20*marks)**

1. State Kepler's first and third law.
2. What is the limit of visibility?
3. Examine why noise temperature is a useful concept in communication receivers?
4. Formulate uplink and downlink equation of a satellite access.
5. Write the features of MATV.
6. A Satellite downlink at 12 GHz operates with a transmit power of 6W and an antenna gain of 48.2Db. Calculate the EIRP in dbw.
7. Point out the pre-assigned TDMA satellite access.
8. How does the spread spectrum system differ from conventional communicational communication systems?
9. What do you infer about GRAMSAT?
10. Outline the three regions to collect the frequency for satellite services.

**PART B-(16 x 5= 80 marks)**

11. (a). (i). Illustrate the orbital parameters used for positioning a satellite.(8)
    (ii). Estimate the suitable equations for look angles and the range for geostationary satellite. (8)

(Or)

(b). (i). Categorize the frequency allocations and draw the frequency spectrum for satellite services. (12)

(ii). Illustrate the effects of non-spherical earth. (4)

12. (a). (i). Justify the reasons behind why the transponders are connected in the communication channel with neat diagrams. (4)

(ii). Analyze the wideband receiver and input de-multiplexer with appropriate diagrams. (12)

(Or)

(b). Examine how the attitude and orbit control system (AOCS) is achieved through spin stabilization systems? Give necessary diagrams. (16)

13. (a). (i) Point out the calculation of link power budget equation. (4)

(ii) List the various types of system noise. Explain in detail. (12)

(Or)

(b). (i) Derive the expression of output back off satellite TWTA output for the downlink communication. (8)

(ii) Calculate the carrier to noise ratio for the combined uplink and downlink communication. (8)

14. (a). (i) Explain FDMA in detail and also enumerate the interference in detail (8)

(ii) Explain direct sequence spread spectrum communication in detail. (8)

(Or)

(b). (i) Identify the band limited and power limited TWT amplifier operation. (10)

(ii) Explain the operation of digital TASI in TDMA operation. (6)

15. (a). Elaborate the main features and services offered by mobile satellite systems. (16)

(Or)

(b). Discuss the services of the following system with its usage.

(i) INTELSAT (4)

(ii) Email (4)

(iii) BTV (4)

(iv) DTH (4)