ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai
Accredited by NAAC
ANGUCHETTYPALAYAM, PANRUTI – 607 106.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PERIOD: AUG 2024 - NOV 2024 **BATCH: 2022 - 2026**

BRANCH: ECE **YEAR/SEM: III/V**

SUB CODE/NAME: CEC352/ SATELLITE COMMUNICATION

QUESTION BANK WITH 2 MARKS ANSWER

UNIT I SATELLITE ORBITS	
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, Geo stationary and non-Geo-stationary orbits – Look Angle Determination – Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures – launch vehicles and propulsion.	
UNIT-I / PART-A	
1	**What is a Satellite?** A Satellite is defined as an artificial body that is projected from Earth to orbit of solar systems. Types: Information satellites and Communication Satellites.
2	**What is the limit of visibility? (Nov/Dec 2016)** The limit of visibility is defined as the east and west limits on the geostationary arc of a satellite which are visible from any given earth station. These limits are set by the geographic coordinates of the Earth station and antenna elevation.
3	**State Kepler's first law. (Nov/Dec 2016) (Apr/May 2017)** It states that the path followed by the satellite around the primary will bean ellipse. An ellipse has two focal points F_1 and F_2. The center of mass of the two-body system, termed the barycenter is always centered on one of the foci. E = ($\sqrt{(a^2 - b^2)}$)/a
4	**State Kepler's second law. (Apr/May 2015)** For equal time intervals, the satellite will sweep out equal areas in its orbital plane. This means that the planet speeds up as it approaches the sun and slows down as it departs from it.
5	**State Kepler's third law. (Nov/Dec 2018) (Nov/Dec 2022) (Apr/May 2024)** 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.
6	**Define apogee. (Nov/Dec 2019) (Apr/May 2022)** Apogee means the maximum distance of the Moon or a satellite gets away from the Earth within its orbit.
7	**Define Perigee. (Nov/Dec 2019) (Apr/May 2022)** Perigee means the closest distance the Moon or a satellite gets to Earth in its orbit.
8	**What are the geostationary satellites? (Apr/May 2014)** The satellites present in the geostationary orbit are called geostationary satellite. The geostationary orbit is one in which the satellite appears stationary relative to the earth. It lies in equatorial plane and inclination is '0°'. The satellite must orbit the earth in the same direction as the earth spin. The orbit is circular.

9	**Differentiate geostationary and geosynchronous satellite. (Apr/May 2021) (A/M 2024)** A geosynchronous satellite is a satellite whose orbital track on the earth repeats regularly over points on the earth over time. If such a satellites orbit lies over the equator and the orbit is circular, it is called geostationary satellite.
10	**Define ascending node. (Nov/Dec 2014)** Ascending node is defined as the point where the orbit crosses the equatorial plane going from south to north.
11	**Define descending node. (Nov/Dec 2014)** Descending node is defined as the point where the orbit crosses the equatorial plane going from north to south.
12	**Define mean anomaly.** Mean anomaly is the average value of the angular position of the satellite with reference to the perigee. It is the angular distance from the pericenter which a fictitious body would have if it moved in a circular orbit, with constant speed, in the same orbital period as the actual body in its elliptical orbit.
13	**Define true anomaly.** True anomaly is the angle from perigee to the satellite position, measured at the earth's center. This gives the true angular position of the satellite in the orbit as a function of time.
14	**Mention the apogee and perigee height.** Apogee (A) means the furthest distance a satellite gets from Earth in its orbit. A is related to the semi-major axis and eccentricity. A=a(1+e). Perigee (P) means the closest distance the satellite gets to Earth in its orbit. P is related to the semi-major axis and eccentricity P=a(1−e).
15	**Identify the basic factors affecting satellite position. (Apr/May 2016) (or)** **How the satellite position is affected? List a few factors? (Nov/Dec 2023)** The basic factors affecting satellite position are Elevation Angle, Coverage Angle, Free Space Loss & Atmospheric Attenuation.
16	**The limit of visibility depends on what factors? Considering an earth station at the equator, with the antenna pointing either west or east along the horizontal calculate the limiting angle. (Apr/May 2016)** Any geostationary satellite has an arc of visibility which can also be called footprint. This depends upon the height of satellite, elevation angle and area of coverage. The limiting angle = arc cos (α_E/α_{GSO}) = arc cos (6378 / 42164) = 81.3°.
17	**Write short notes on station keeping. (Apr/May 2016)** 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 is initially placed in the correct orbit, natural forces induce a progressive drift.
18	**What is look angle?** The coordinates to which an earth station must be pointed to communicate with a satellite. The azimuth and elevation angles of the ground station antenna are termed as look angles.
19	**Write short notes on station keeping. (Apr/May 2016)** It is the process of maintaining 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 is initially placed in the correct orbit, natural forces induce a progressive drift.

20	**Which parameters decide the system reliability? (Apr/May 2015)** Overall reliability of a satellite is governed by the reliability of its critical spacecraft components.
21	**A satellite moving is orbiting in the equatorial plane with a period from period from perigee to perigee of 12hrs. Given the eccentricity is 0.02. Calculate the semi-major axis. The earth's equatorial radius is 6378.1414km. (Nov/Dec 2013)** Given e=0.02 $\mu=3.986005\times10^{14}$ α_E=6378.1414km Mean motion $n=2\pi/p=2\pi/12=1.454\times10^{-4}s^{-1}$ $a=(\mu/n^2)^{1/3}$=26610km.
22	**A satellite is orbiting in the equatorial plane with a period from period from perigee to perigee of 15hrs. The eccentricity is 0.002 and the inclination of the orbit is zero-degree K_1=66063km^2 $\mu=4x10^{14}$m^3/s^2. Calculate the semi-major axis. The earth's equatorial radius is 6378014 km. (April/May 2024) (R-2017)** **Given** e=0.002, $\mu=4\times10^{14}$, α_E=6378014km **Solution** Mean motion $n=2\pi/p=2\pi/15=1.162\times10^{-4}s^{-1}$ $a=(\mu/n^2)^{1/3} = (4\times10^{14}/(1.162x10\text{^}-4)^2)^{1/3}$ = 142.917 km
23	**Differentiate ascending node from descending node. (Apr/May 2015)** In ascending node, the point at which the orbit crosses the equatorial plane goes from south to north. In descending node, the point at which the orbit crosses the equatorial plane goes from north to south.
24	**Find the viewing angle of a geostationary satellite orbiting at 42000km from an earth station making an elevation angle of 25 degrees. (Nov/Dec 2014)** $d = \sqrt{R^2 + a_{GSO}^2 - 2Ra_{GSO}\cos b} = \sqrt{42000^2 + 42164^2 - 2\times42000\times42164\times\cos 25^\circ}$ = 18217Km El = arc cos$\left(\frac{a_{GSO}}{d}\sin b\right)$ = arc cos $\left(\frac{42164}{18217}\sin 25^\circ\right)$ = 12°
25	**List the differences between LEO and MEO satellites. (Nov/Dec 2014)**

LEO	MEO
LEO stands for Low Earth Orbit	MEO stands for Middle Earth Orbit
LEO satellite range is 500 to 1500 km	MEO satellite range is 8000 to 18000 km
Smaller area of coverage	Larger coverage area
Visible for 15 to 20 minutes	Visible for 2 to 8 hours

26	**What are the features of LEO? (Apr/May 2015)** Low Earth orbit (LEO) is an orbit around Earth with an altitude between 160 kilometers and 2,000 kilometers. A low Earth orbit is simplest and cheapest for satellite placement. It provides high bandwidth and low communication time lag (latency), but satellites in LEO will not be visible from any given point on the Earth at all times.
27	**Define orbital period. (Apr/May 2017)** It is defined as the time it takes to complete one full orbit around a celestial body and it also depends on the altitude of the satellite Kepler's third law relates the period and the radius of

<table>
<tr><td></td><td>objects in orbit around a star or planet.</td></tr>
<tr><td>28</td><td>What is prograde orbit direct orbit? (Nov/Dec 2019)
An orbit in which satellite moves in the same direction as the Earth's rotation. Its inclination is always between 0^0 to 90^0. Many satellites follow this path as Earth's velocity makes it easier to lunch these satellites.</td></tr>
<tr><td>29</td><td>What is a geostationary orbit? (Nov/Dec 2017) (Apr/May 2023)
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 which is directly over the same patch of ground stations at all times.</td></tr>
<tr><td>30</td><td>Distinguish between LEO system and GEO system. (Nov/Dec 2018)
<table>
<tr><th>Parameter</th><th>LEO</th><th>GEO</th></tr>
<tr><td>1. Orbital period</td><td>24 hours</td><td>10 o 40 minutes</td></tr>
<tr><td>2. Satellite height</td><td>35,800 km</td><td>500 1500 km</td></tr>
<tr><td>3. Propagation loss</td><td>Highest</td><td>least</td></tr>
<tr><td>4. Advantages</td><td>Covers large geographical area, only three GEO satellites are needed to cover earth</td><td>LEO satellite provides better signal strength. It has least signal propagation delay since it is closest to earth.</td></tr>
<tr><td>5. Disadvantages</td><td>Considerable time delay in the signal, which is not favorable for point to point communication.</td><td>Very costly, Atmospheric drag effects are more which cause gradual orbital disorientation</td></tr>
<tr><td>6. Orbital period</td><td>24 hours</td><td>10 to 40 minutes</td></tr>
</table></td></tr>
<tr><td>31</td><td>Name the Keplerian element set. (Apr/May 2018)
The six Keplerian elements are: Eccentricity I, Semi major axis (a), Mean anomaly (Mo), Argument of perigee (ω), Inclination (i), Right ascension (Ω).</td></tr>
<tr><td>32</td><td>What is meant by sun transit outage? (Apr/May 2018) (Apr/May 2022) (Nov/Dec 2022) (Apr/May 2023)
Sun transit outage is an interruption in, or distortion of geostationary satellite signals caused by interference from solar radiation. Sun appears to be an extremely noisy source that completely blanks out the signal from satellite. This effect lasts for 6 days around the equinoxes. They occur for a maximum period of 10 minutes.</td></tr>
<tr><td>33</td><td>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 (Apr/May 2021)
Given: eccentricity I = 0.6; perigee (R_p) = 1000
$R_p = a (1-e)$
1000 = a (1-0.6) => a (semi major axis) = 2500 Km.
By Kepler's law; period of revolution $T^2 = a^3$ => T = 125000 Sec.</td></tr>
</table>

34	**Assume a circular orbit: Using Newton's law of gravitation and Newton's second law, determine the acceleration of a satellite. (Apr/May 2021)** By Newton's second law of motion F= ma (1) By Newton's law of gravitation $F=GmM/r^2$ (2) Equating equation (1) & (2) => a =Gm/r^2
35	**State the necessity of kick start motors? (Nov/Dec 2023)** Kick Motor refers to a rocket motor that is regularly employed on artificial satellites destined for a geostationary orbit. As the vast majority of geostationary satellite launches are carried out from spaceports at a significant distance away from Earth's equator, the carrier rocket would only be able to launch the satellite into an elliptical orbit of maximum apogee 35,784-kilometres and with a non-zero inclination approximately equal to the latitude of the launch site.
36	**When does the satellite remain in orbit forever? (R-2021) (Nov/Dec 2023)** If the satellite was moving through empty space it would stay in its orbit forever, there being no forces acting to speed it up or to slow it down.
	List the kinds of hydrazine used for LV propulsion? (R-2021) (Nov/Dec 2023) Monopropellant hydrazine Bipropellant hydrazine (N_2H_4)
UNIT-I / PART-B & C	
1	Explain how Keplers's and Newton's law are used to describe the orbit**.** Explain about satellite launch vehicles. **(13 Marks) (Nov/Dec 2019)**
2	Describe the terms of earth orbiting satellites. **(13 Marks) (Apr/May 2016) (or)** Define the types of orbital parameters. **(6Marks) (R-2021) (Nov/Dec 2023)**
3	Describe the theory and analysis in determining the look angles of the satellite **(13)(A/M 24)**
4	(a) Describe the steps involved in launching a satellite. **(Apr/May 2016), (Apr/May 2015) & (Nov/Dec2014).** (b) What are the different types of satellite orbits? Discuss their merits and demerits**. (Nov/Dec 2014) (Apr/May 2017).**
5	A satellite in polar orbit has a perigee height of 600 km and an apogee height of 1200 km. Calculate the mean motion and the rate of regression of the nodes. Assume the polar radius of the earth to be equal to 6357 kms. **(Apr/May 2016)**
6	(i)State and Explain Keplers three laws of motion with suitable diagrams**. (April /May 2018) (Apr/May 2023)** (ii) 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. **(Apr/May 2023)** (iii) Write a brief note on Atmospheric drag. **(Apr/May 2015). (April /May 2018) (Apr/May 2023)**
7	Determine the limits of visibility for an earth station situated at mean sea level, at a latitude48.42° north and longitude 89.26° west. Assume a minimum angle of elevation 5°, a_{GSO}= 42164km and R=6371 km **(Apr/May 2015) (Apr/May 2023)**
8	(i) Illustrate the orbital parameters used for positioning a satellite. **(6 Marks) (Nov/Dec 2016)** (ii)Estimate the suitable equations for look angles and the range for geostationary satellite.

	(6 marks) (Nov/Dec 2016)
9	An ophthalmology department is planning to perform CATRACT surgery for patients through experts using a satellite link. How Kepler's Law of planetary motion support in launching a satellite for such applications? Discuss the Conceptual view. **(13 Marks) (April/May 2022)**
10	Derive the equations which permit the elevation angle to be calculated. **(13 Marks) (Apr/May 2017)**
11	State and explain the parameters for Earth orbiting satellites. **(13 Marks) (Nov/Dec 2017)**
12	Describe in detail the launching procedure of a satellite. **(7 Marks) (Nov/Dec 2017)**
13	What is the principle Liquid Propulsion System? Explain the specific technologies under the category of Electric and ion propulsion**. (13 Marks) (Nov/Dec 2018)**
14	Explain the features of typical satellite launch vehicles. **(7 Marks) (R-2021) (N/Dec 2023)**
15	(i) Draw and explain the geometry for determining the sub satellite point. **(6 Marks)** (ii) Explain and illustrate the limits of visibility in satellite orbits. **(7 Marks) (April /May 2018) (Apr/May 2023)**
16	i) Explain the orbital perturbations. **(13 Marks) (Nov/Dec 2019) (April/May 2022)** ii) What is meant by the geo stationary orbit and also explain the conditions to be required for an orbit to be geo stationary? **(Nov/Dec 2019)**
17	Explain orbital perturbations and the methodologies to mitigate the same. **(13 Marks) (April/May 2024)**
18	Derive the complete expression for Look Angles, along with intermediate angle in satellite communication. Show that intermediate angle is: **(13 Marks) (Apr/May 2021)** $\alpha = tan^{-1}[\frac{\tan\lvert l_s - l_e \rvert}{SinL_e}]$
19	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 Marks) (Apr/May 2021)**
20	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 irginia 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 Marks) (Apr/May 2021) (PART C)**
21	A satellite in polar orbit has a perigee height of 600km and an Apogee height of 1200km. Determine (1) mean motion (2) rate of regression of the nodes (3) rate of rotation of the line of apsides. Assume a mean value of 6371 Km for the earth's radius. **(10 Marks) (Apr/May 2022)**
22	A geostationary satellite is located at 90 degrees W. Calculate the azimuth angle for an earth station antenna at latitude 35degree N and longitude 100 degrees W. Also, find the range and antenna elevation angle. **(10 Marks) (Apr/May 2023)**
23	Explain in detail about orbital elements and orbital perturbations with suitable example. **(13 Marks) (Nov/Dec 2022)**
24	Give a detailed note on launching vehicles and the procedures employed for launching

	spacecraft in GEO orbits. **(13 Marks) (Nov/Dec 2022)**
25	A ground station lies at latitude of 39.2906 degrees N and longitude of 280.2629 degrees E. A Geostationary satellite at a radius of 42164 km has a longitude of 280.2629 degrees E. Calculate the range and lookup angles (azimuth and elevation angles) of the satellite. **(5 Marks) (Apr/May 2021) (Nov/Dec 2022) (PART C)**
26	Differentiate geostationary and geosynchronous satellite. **(3 Marks) (Apr/May 2021) (PART C)**
27	State Keplers laws of planetary motion. Demonstrate their with reference to artificial satellites orbiting the earth. **(13 Marks) (Nov/Dec 2023)**
28	What do you mean by look angles? How they are determined for a geostationary orbit? Give Details. **(13 Marks) (Nov/Dec 2023)**
29	Derive the necessary equations for a satellite orbit and launching procedures method explain in detail. **(13 Marks) (April/May 2024) (R-2017)**
30	Give explanation in detail about the geocentric equatorial coordinate system which is based on the earth's equatorial plane. **(13 Marks) (April/May 2024) (R-2017)**
UNIT II SPACE SEGMENT	
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-the Antenna Subsystem.	
UNIT-II	
1	**Give the two segments of basic satellite communication.** Two segments of basic satellite are: Earth segment (or) ground segment & Space segment
2	**Write short notes on altitude control system.** It is the system that achieves and maintains the required attitudes. The main functions of attitude control system include maintaining accurate satellite position throughout the life span of the system.
3	**Define payload and transponder? (Apr/May 2021) (Nov/Dec 2022) (Apr/May 2022)** Payloads in satellites are the scientific instruments carried by that satellite. A satellite can have multiple payloads for different type of operations in space. In a communication satellite, the equipment which provides the connecting link between the satellite's transmit and receive antennas is referred to as the transponder.
4	**Why should an omnidirectional antenna be used aboard a satellite for telemetry and command during the launch phase? (Apr/May 2016)** Certain frequencies have been designated by international agreement for satellite telemetry transmissions. During the transfer and drift orbital phases of the satellite launch, a special channel is used along with an omnidirectional antenna. Once the satellite is on station, one of the normal communications transponders may be used along with its directional antenna, unless some emergency arises which makes it necessary to switch back to the special channel used during the transfer orbit.
5	**What is meant by Pitch angle?** Pitch angle is the degree of elevation or depression. Movement of a spacecraft about an axis which is perpendicular to its longitudinal axis.
6	**What is Yaw?** Yaw is the rotation of a vehicle about its vertical axis. A yaw rotation is a movement around the yaw axis of a rigid body that changes the direction it is pointing, to the left or right of its

	direction of motion.
7	**Write short notes on the spin stabilized satellites.** In a spin stabilized satellite, the body of the satellite spins at about 30 to 100 rpm about the axis perpendicular to the orbital plane. The satellites are normally dual spin satellites with a spinning section and a despun section on which antennas are mounted. These are kept stationary with respect to earth by counter rotating the despun section.
8	**What is meant by momentum wheel stabilization?** During the spin stabilization, flywheels may be used rather than spinning the satellite. These flywheels are termed as momentum wheels.
9	**What is the function of Telemetry Tracking and Command (TT&C)? (Apr/May 2023)** Telemetry, tracking, and command is used for communication between spacecraft and the ground systems. The subsystem functions are: Controlling of spacecraft by the operator on earth. Receive the uplink commands, process and send them to other subsystems for implication. The purpose of TT& C function is to ensure the satellite performs correctly.
10	**Examine why noise temperature is a useful concept in communication receiver (Nov/Dec 2016)** 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.
11	**What is the basic form of a cassegrain antenna? (Apr/May 2016)** Earth station feed systems most commonly used in satellite communication are Primary feeds, Cassegrain & Offset feed. Common Cassegrain type of antenna is a dual assembly of paraboloid main reflector and sub reflector. The feed is located at one of the sub reflectors, which is closer to the main reflector.
12	**What is an OMT?** The polarization separation takes place in a device known as an orthocoupler or Orthogonal Mode Transducer (OMT).
13	**State the reason for the high-power amplifier in earth stations deploying some sort of redundancy configuration. (Apr/May 2016)** Reliability is of utmost importance in satellite communications. When a single high-power amplifier is used, transmission will stop upon its failure. Therefore, the high power amplifier in earth station always employs some sort of redundancy configuration.
14	**What is split body stabilization? (Nov/Dec 2014)** The body of the satellite remains fixed to the earth so the 3-axis stabilization is also referred to as split body stabilization.
15	**Write the objective with the downlink of any satellite communication system must be designed. (Apr/May 2014)** (2) To guarantee the continuity of the link for a specified percentage of the time with the given S/N (ii) To carry the maximum number of channels at a minimum capital and maintenance cost.
16	**What are the effects to which the displacement in association with tracking feeds gives rise? (Apr/May 2017)**

The problem of making a tracking feed can best be understood by considering the field in the focal region of a paraboloid when a satellite beacon transmitter is slightly off axis.
The focal plane distribution will be unchanged in form, but displaced from the horn axis and the direction of displacement in angle corresponds to the position of the satellite.
The displacement gives rise to three effects.

17 **How do you characterize uplink and downlink? (Apr/May 2017)**

Two frequencies are necessary for communication between a ground station and a satellite; one for communication from the ground station on the earth to the satellite called uplink frequency and another frequency for communication from the satellite to a station on the earth, called downlink frequency. These frequencies are divided in several bands such as L, S, Ku, etc are in the gigahertz (microwave) frequency range as shown in Table.

Band	Downlink Frequency (GHz)	Uplink Frequency (GHz)	Bandwidth (MHz)
L	1.5	1.6	15
S	1.9	2.2	70
C	4	6	500
Ku	11	14	500
Ka	20	30	3500

18 **What is the need for thermal control and propulsion? (Nov/Dec 2013) (Apr/May 2015) (Nov/Dec 2017) (Apr/May 2022)**

The use of thermal control is to operate the satellite in temperature stable environment
A solid or liquid substance burnt in a rocket for the purpose of producing thrust.

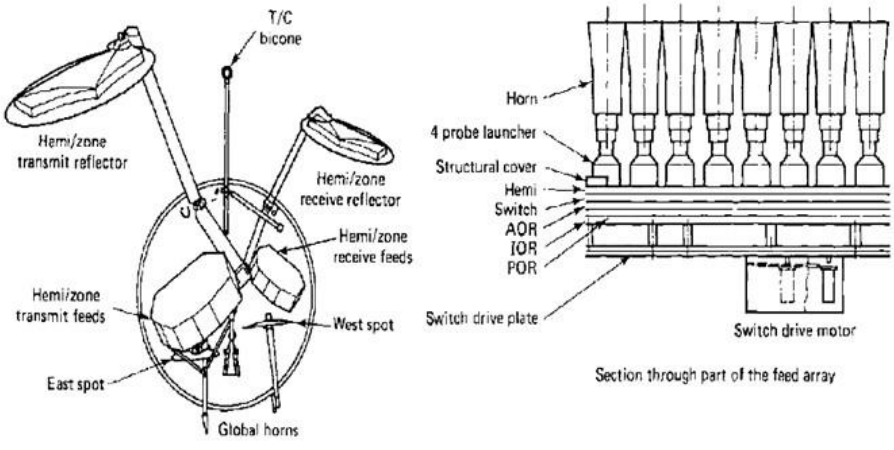
19 **What is the use of frequency reuse technique in communication subsystem and how it is employed? (April/May 2018) (Nov/Dec 2023)**

The satellite as a whole to be accessed by earth stations widely separated geographically but transmitting on the same frequency that is known as frequency reuse. It can be implemented by Space Division Multiple Access (SDMA).

20 **What is TWTA?**

TWTA means Traveling Wave Tube Amplifier. The TWTA is widely used in transponder to provide the final output power required to the transducer and its power supplies.

21 **Draw the block diagram of antenna subsystem. (Apr/May 2021)**



Section through part of the feed array

22	**Estimate 3-dB beamwidth of a parabolic reflector antenna having 30m diameter at 6 GHz. (Apr/May 2023)** $\lambda = c/f = 0.3/6 = 0.05\ m$ $\theta 3dB = 70\ (\lambda\ D)\ degrees = 70\ (0.05\ 30) = 0.12°$
23	**How stabilization by momentum wheel is achieved? Demonstrate. (Nov/Dec 2023)** During the spin stabilization, flywheels may be used rather than spinning the satellite. These flywheels are termed as momentum wheels. When a momentum wheel is operated with zero momentum bias, it is generally referred to as a reaction wheel. Reaction wheels are used in three axis stabilized systems. Reaction wheels can also be combined with a momentum wheel to provide the control needed
	UNIT-II / PART-B
1	Compare and contrast spinning satellite stabilization and momentum wheel stabilization (or) Explain how altitude and orbit control is achieved from a earth station. (or)Explain in detail with necessary schematics the spin stabilization technique and momentum wheel stabilization technique to keep satellites attitude control. (or) Explain the procedure used for attitude control of satellite with necessary diagrams**. (Nov/Dec 2017) (Nov/Dec 2022) (Apr/May 2023) (13 Marks)**
2	Examine how the attitude and orbit control system (AOCS) is achieved through spin stabilization system? Give necessary diagrams. **(13 Marks) (Nov/Dec 2019)**
3	Analyze the wideband receiver and input de-multiplexer with appropriate diagrams. **(13 Marks) (Apr/May 2023)**
4	What are the various elements used in the space segments of a satellite system? Explain the need and function of each element in the satellite system. **(13 Marks) (Apr/May 2022)**
5	What are the three main systems for tracking satellites? How can tracking systems be affected? What are the main functions of TTC subsystem? Explain. **(13 Marks) (Apr/May 2017)**
6	Discuss on the TWTA power amplifier used in a satellite transponder and its power output. **(13 Marks) (Nov/Dec 2017)**
7	The thermal control system represents a common denominator for all operating elements of the spacecraft- Justify. **(13 Marks) (Nov/Dec 2019)**
8	(i) Describe the East West and North South station keeping maneuvers required in satellite station keeping. (ii) Explain what is meant by satellite attitude and briefly describe two forms of attitude control. **(13 Marks) (Apr/May 2018) (Apr/May 2022)**
9	(i) Explain the working of telemetry, tracking and control with a suitable diagram. (ii) Explain what is meant by thermal control and why this is necessary in a satellite. **(13 Marks) (Apr/May 2018) (Nov/Dec 2019)**
10	Define and explain the terms roll, pitch and yaw. **(3 Marks) (Apr/May 2021)**
11	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 Marks) (Apr/May 2021)**
12	Explain Spin Stabilization and Three-axis Stabilization. **(5 Marks) (Apr/May 2021)**
13	Explain what is meant by thermal control and why this is necessary in a satellite. **(4 Marks) (Apr/May 2021)**
14	Explain what is meant by satellite attitude and briefly describe two forms of attitude control.

	(4 Marks) (Apr/May 2021)
15	What are the various subsystems in the space segment of a satellite communication system? Explain the need and function of each subsystem. **(13 Marks) (Nov/Dec 2022)**
16	List the variety of antennas employed for satellite communication. Explain about antenna subsystem in detail **(13 Marks) (Nov/Dec 2023)**
17	How spin stabilization of systems is achieved through attitude and orbit control systems? Give Essential sketches and explain. **(13 Marks) (Nov/Dec 2023)**
18	Explain the block diagram of generalized spacecraft TTC systems. **(13 Marks) (Nov/Dec 2023) (R-2021) (Nov/Dec 2023) (PART - C)**
19	Explain the applications of thermal control in space craft design. **(13) (N/D 2023) (R-2021)**
UNIT III SATELLITE LINK DESIGN	
Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.	
UNIT-III/ PART-A	
1	**What are the earth station parameters affecting C/N ratio? (April 2014)** (i)The antenna gain when receiving the wanted transmission (ii) The system noise temperature at the frequency of the transmission.
2	**Define sky noise.** Sky noise is a term used to describe the microwave radiation which is present throughout universe and which appears to originate from matter in any form, at finite temperature.
3	**An antenna has a noise temperature of 35K and it is matched into a receiver which has a noise temperature of 100K.Claculate the noise power density and the noise power for a BW of 36MHz. (Nov 2013)** $N_0=(35+100)\times1.38\times10^{-23}=1.86\times10^{-21}$ J and $P_N=1.86\times10^{-21}\times36\times10^{6}=0.067$ pW
4	**What is terrestrial interface? (Nov 2013) (Nov/Dec 2022)** Terrestrial interface is the interconnection with whatever terrestrial system, if any is involved. In the case of small receive only or transmit only stations, the user may be at earth station itself.
5	**Define antenna gain. (Nov/Dec 2014)** The gain of the antenna is the ratio of the maximum radiation to that of the isotropic radiator of the same radius r. Gain, $G = \frac{\Psi_M}{\Psi_i}$
6	**A satellite downlink at 10 GHz operates with a transmit power of 6 W and an antenna gain of 48.2dB. Calculate the EIRP (dBW). (Apr/May 2022)** EIRP = 10 log 6 + 48.2 = 56 dBW.
7	**Write the relationship between EIRP and antenna gain? (N/D 2018) (N/D 2023) (R-21)** The relationship between EIRP and antenna gain is EIRP= Pt*Gt Pt- transmit power; Gt- transmit antenna gain.
8	**Why is the satellite link probably the most basic in microwave communications? (Nov/Dec 2018)** Microwave frequencies are used in satellite communication because they require line of sight between the sender and receiver which is not possible in terrestrial communication links. As a result, the satellites can cover large distances compared to terrestrial links.
9	**What is called antenna noise?** Antennas operating in the receiving mode introduce noise into the satellite circuit. Noise

	will be introduced by the satellite receive antenna and the ground station receive antenna.
10	**The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.** [Free space loss] = 32.4 + 20 log 42000 + 20 log 6000 = 200.4 dB
11	**What is EIRP? (Nov/Dec 2023)** Equivalent Isotropic Radiated Power is a measure of radiated or transmitted power of an antenna. It can be calculated from the antenna gain & the power fed to the antenna input.
12	**What is noise power spectral density? (April/May 2018)** Noise power per unit BW is termed the NPS density. $N_0 = P_N/B_N = KT_N$ joules.
13	**Define noise factor. (Nov/Dec 2017) (Nov/Dec 2022) (April/May 2021)** Noise factor is defined as an alternative way of representing amplifier noise. In defining the noise factor of an amplifier, the source is taken to be at room temperature denoted by T_o which is usually taken as 290K, hence the output noise from the amplifier is $N_{0,out} = F\,GKT_0$. Where G is available power gain of the amplifier and F is its noise factor.
14	**Define saturation flux density.** The flux density required at the receiving antenna to produce saturation of TWTA is termed the saturation flux density.
15	**What are the factors contributing to noise in an earth station receiving channel?** The factors are Gain / Noise Temperature (G/T ratio), EIRP, Noise factor and Noise figure.
16	**List the ionospheric effects on space link. (Apr/May 2023)** ❖ Ionization through solar radiation ❖ Solar activity cycle ❖ Scintillation (high turbulence) after sunset ❖ Traveling Ionospheric Disturbances (TIDs)
17	**Formulate uplink and downlink equation of a satellite access (Nov/Dec 2016)** **Uplink Equation** $\left[\frac{C}{N_o}\right]_U = [EIRP]_U - [BO]_i - [LOSSES]_U + \left[\frac{G_R}{T_S}\right]_U - [K]$ **Downlink Equation** $\left[\frac{C}{N_o}\right]_D = [EIRP]_D - [BO]_O - [LOSSES]_D + \left[\frac{G_R}{T_S}\right]_D - [K]$
18	**A receiving system has antenna noise temperature of 60K & its receiver noise figure 9dB. Find the system noise temperature if room temperature is 290K. (Nov/Dec 2019)** $T_e = (F-1)T_0$ 10log F=9dB F=7.94 T_e =(7.94-1)290=2012.6K
19	**State the basic requirements of an earth station antenna. (Nov/Dec 2019)** High gain value Narrow beam width and low side lobe level Broadband Low noise temperature

	Low loss Good rotation capability
20	**For a satellite circuit, the individual link carrier-to-noise spectral density ratios are: uplink 100 dBHz and downlink 87 dBHz. Calculate the combined C/N_0 ratio. (Apr/May 2022)** $N_0/C = (N_0/C)_U + (N_0/C)_D = 10^{-10} + 10^{-8.7} = 2.095\times10^{-9}$ $[C/N_0] = -10\log(2.095\times10^{-9}) = 86.79$ dBHz
21	**Calculate the gain in decibels of a 3-m paraboloidal antenna operating at a frequency of 12 GHz. Assume an aperture efficiency of 0.55.** $G = \eta(10.472fD)^2 = 0.55 \times (10.472 \times 12 \times 3)^2 = 78168$ $[G] = 10\log 78168 = 48.9\,dB$
22	**A satellite link operating at 14 GHz has receiver feeder losses of 1.5 dB and a free-space loss of 207 dB. The atmospheric absorption loss is 0.5 dB, and the antenna pointing loss is 0.5 dB.** **Depolarization losses may be neglected. Calculate the total link loss for clear-sky conditions.** $[LOSSES] = [FSL] + [RFL] + [AML] + [AA]$ $= 207 + 1.5 + 0.5 + 0.5$ $= 209.5\,dB$
23	**Give the expression for deducing system noise temperature of cascaded amplifier stages.** $T_S = T_{ant} + T_{e1} + \frac{T_{e2}}{G_1} + \frac{T_{e3}}{G_1G_2} + \cdots$
24	**An LNA is connected to a receiver which has a noise figure of 12 dB. The gain of the LNA is 40 dB, and its noise temperature is 120 K. Calculate the overall noise temperature referred to the LNA input.** $[F] = 10\log F = 12 \Rightarrow F = 10^{1.2} = 15.85$ $T_{e2} = (F-1)T_0 = (15.85-1)\times 290 = 4306\,K$ $[G_1] = 10\log G_1 = 40 \Rightarrow G_1 = 10^4$ $T_{in} = T_{e1} + \frac{T_{e2}}{G_1} = 120 + \frac{4306}{10^4} = 120.43\,K$
25	**Mention the system attributes that will generate intermodulation products.** Intermodulation occurs where multiple carriers pass through any device with nonlinear characteristics. In satellite communications systems, this most commonly occurs in the traveling wave tube HPA aboard the satellite. Both amplitude and phase nonlinearities give rise to intermodulation products. Third order intermodulation products fall on neighboring carrier frequencies, where they result in interference.
26	**A satellite downlink at 12 GHz operates with a transmission power of 6W and a antenna gain of 48.2 dB. Estimate EIRP in dBW. (Apr/May 2023)** $[EIRP] = [PS] + [G]$ dBW; $[EIRP] = 10\log(6\ 1) + 48.2 = 56\,dBW$
27	**What do you mean by intermodulation noise? How it occurs in a link?** Intermodulation noise is due to the presence of the products of intermodulation. If a number of signals are passed through a non-linear device the result will be intermodulation

	products that are spurious frequency components. These components may be inside or outside the frequency band of interest for the device. In satellite communications systems, this most commonly occurs in the traveling wave tube HPA aboard the satellite. Both amplitude and phase nonlinearities give rise to intermodulation products.
28	**List the examples of return link applications?** Telephone, radio, television, internet, and military applications use satellite communications.
	UNIT-III / PART-B
1	Derive the [C/No] ratio for satellite uplink in terms of input back off. **(8 Marks) (Apr/May 2023)**
2	Summarize the procedures involved in test equipment measurements on G/T, C/N_o and EIRP with reference to the Earth segment **(Apr/May 2016)** (or) Derive the downlink C/N ratio for the satellite. **(8 Marks) (Apr/May 2015), (Nov/Dec 2016), (Apr/May 2022)**
3	a) Explain how intermodulation noise originates in a satellite link and explain how it is reduced? b) Derive the link – power budget equation. **(13 Marks) (Apr/May 2015), (Nov/Dec 2016)**
4	i) From the calculation of system noise temperature prove that C/N ratio is directly proportional to G/T ratio. **(8 Marks)** ii) Consider the receive side of an earth station. The antenna gain is 65dB, and its noise contribution is 60 K. The waveguide loss is 0.5dB. Determine the equivalent noise temperature of LNA assuming that the noise contribution by the down converter is negligible and earth station G/T is 40dB/K. (T_o =300K). **(5 Marks) (Apr/May 2017)**
5	i) Illustrate in detail about the free space transmission. **(8 Marks)** ii)The range between a ground station and a satellite is 42,000 km. Calculate the free space loss at a frequency of 10GHz. **(5 Marks) (Nov/Dec 2017)**
6	Explain the impacts of rain or link performance. Consider the governing equation for uplink and downlink rain fade margin. Elaborate in detail. **(13 Marks) (Apr/May 2022)**
7	Briefly explain in detail the effects of rain in uplink and downlink in satellite communication. **(13 Marks) (Nov/Dec 2017) (Apr/May 2023) (Nov/Dec 2022)**
8	List and explain the steps of Link power Budget analysis for Downlink. **(8 Marks) (Nov/Dec 2018) (Apr/May 2022)**
9	(i) In a link budget calculation at 12Ghz the free space loss is 20dB, the antenna pointing loss is 1dB and atmospheric absorption is 2dB. The receiver [G/T] is19.5dB/K and the receiver feeder loss is 1dB. The EIRP is 48dBw. Calculate the carrier to noise power spectral density ratio. **(8 Marks) (Apr/May 2018)**
10	Explain in detail about Free space transmission losses, feeder losses and misalignment losses in space link. **(8 Marks) (Apr/May 2018) (Nov/Dec 2019) (Nov/Dec 2022)**
11	In a link budget calculation at 12GHz, the free space loss is 206dB, the antenna pointing loss is 1dB, and the atmospheric absorption is 2dB. The receiver G/T is 19.5 dB/K, and the receiver feeder losses are 1 dB. The EIRP is 48DBW. Calculate the carrier to noise spectral density ratio. **(8 Marks) (Nov/Dec 2019)**
12	i)An uplink operates at 14GHz, and the flux density required to saturate the transponder is -

	120dB (W/m^2). The free space loss is 207dB and the other propagation losses amount to 2dB. Calculate the EIRP required for saturation assuming clear sky conditions. Assume RFL is negligible. ii) Draw the basic arrangement for the detection of the unique word. iii)Define EIRP and derive the formula for it in decibels. **(13 Marks) (Nov/Dec 2019)**
13	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 Marks) (Nov/Dec 2020) (Apr/May 2021)**
14	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 Marks) (Nov/Dec 2020) (Apr/May 2021)**
15	(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/m2 and (b) in dBW/m2 at the antenna. **(5 Marks) (Nov/Dec 2020) (Apr/May 2021)**
16	(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 Marks) (Nov/Dec 2020) (Apr/May 2021)**
17	The specified parameters for a downlink are satellite saturation value of EIRP, 25 dBW; output back off, 6dB; free-space loss, 196 dB, allowance for other downlink losses, 1.5dB; and earth-station G/T, 41 dBK^{-1}. Calculate the carrier-to-noise density ratio at the earth station. **(8 Marks) (Apr/May 2022)**
18	A satellite TV signal occupies the full transponder bandwidth of 36 MHz, and it must provide a C/N ratio at the destination earth station of 22 dB. Given that the total transmission losses is 200 dB and the destination earth-station G/T ratio is 31dB/K, calculate the satellite EIRP required. **(5 Marks) (Apr/May 2023)**
19	How the Performance of the system affects due to system noise? Derive the expression for system noise at the receiving earth station. **(13 Marks) (Apr/May 2022)**
20	Derive the satellite link design equation and explain in detail **(13 Marks) (Nov/Dec 2023)**
21	Outline how the signal propagation are affected during rainy season and also explain ionospheric effects in details. **(13 Marks) (Nov/Dec 2023)**
22	Explain the design aspects of satellite link. Draw the block diagram and equivalent circuit of earth station receiver for system noise temperature calculation. **(9+4) (Nov/D 2023) (R-21)**
23	List the tropospheric effects on satellite link. Explain the steps of link budget analysis of downlink. **(5+8) (Nov/Dec 2023) (R-21)**

UNIT IV SATELLITE ACCESS AND CODING METHODS

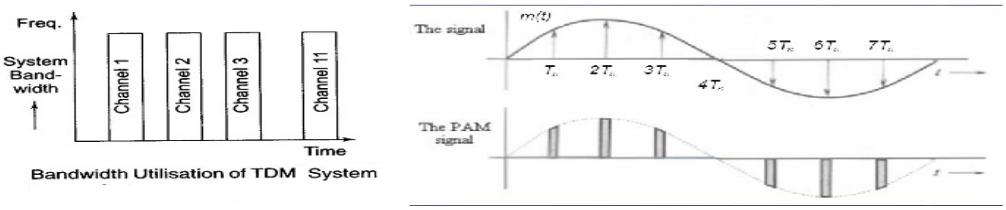
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.

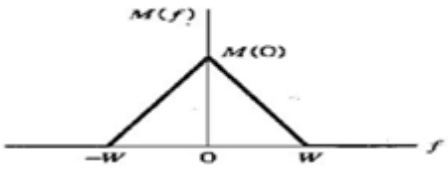
UNIT-IV / PART-A

1	**What is a single mode of operation?** A transponder channel abroad a satellite may be fully loaded by a single transmission from an earth station. This is referred to as a single access mode of operation.
2	**What are the methods of multiple access techniques?** Frequency Division Multiple Access and Time Division Multiple Access techniques.
3	**What is CDMA? (Nov/Dec 2022)** Code Division Multiple Access Techniques In this method, each signal is associated with a particular code that is used to spread the signal in frequency and time.
4	**Give the types of CDMA.** Spread spectrum multiple access • Pulse address multiple access
5	**What is a thin route service?** Single carrier per channel **(**SCPC) systems are widely used on lightly loaded routes, this type of service being referred to as a thin route service.
6	**Define postamble. (Nov/Dec 2017)** Postamble is used to indicate the end of the time slot. In a certain phase detector system, the phase detector must be allowed time to recover from one burst before the next burst is received by it. This is termed as detector quenching and a time slot is referred to as postamble in TDMA system.
7	**What are the advantages of TDMA over FDMA? (Nov/Dec 2014)** Time Division Multiple Access Techniques Only one carrier uses the transponder at any one time, and therefore intermodulation products, which results from the non-linear amplification of multiple carriers are absent.
8	**What is preamble?** Certain time slots at the beginning of each burst are used to carry timing and synchronizing information. These time slots collectively are referred to as preamble.
9	**Define guard time.** Guard time is defined as a time gap between bursts. 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.
10	**What is meant by decoding quenching?** In certain phase detection systems, the phase detector must be allowed for some time to recover from one burst before the next burst is received by it.
11	**What are the types of digital speech interpolation? (April 2014)** Digital time assignment speech interpolation • Speech predictive encoded communication.
12	**Distinguish centrally controlled random access for satellite access from distributed controlled random access. (Apr/May 2016) (Apr/May 2023)**

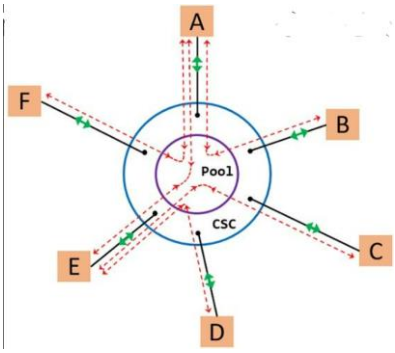
Centrally controlled random access	**Distributed controlled random access**

	As individual terminals do not perform the function of channel assignment terminal's cost is low. As centralized control maintains the status of overall system, depending on the traffic load the capacity of the each station can be varied accordingly.	As no unique controller is used, the reliability is good. As each station maintains a database, failure of one station do not affect the other, but at the same time to maintain a database in each terminal of earth station makes the terminal cost high.
13	**How does the spread spectrum system differ from conventional communication systems? (Nov/Dec 2016)** The spread spectrum system undergo double modulation, First modulation – Carrier and message signal Second Modulation- the resultant signal and PN code sequence, which spreads the spectrum over the available bandwidth.	
14	**What is a single access? (May/June 2015)** A transponder channel aboard a satellite may be fully loaded by a single transmission from earth station.	
15	**What is multiple access technique? (May/June 2015)** A transponder can be loaded by a number of carriers. These may originate from a number of earth station may transmit one or more of the carriers. This mode of operation is known as multiple access technique.	
16	**Define Multiplexing. (April 2014) (Nov/Dec 2014)** Multiplexing is defined as the process of separating the channel transmitted by a single earth station to prevent them from interfering with each other.	
17	**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 that is known as frequency reuse. This method of access known as space division multiple access.	
18	**What is an error detecting code?** A code which allows for the detection of errors is termed as error detecting code. Examples of this coding techniques are parity coding, cyclic redundancy check technique, Check sum techniques.	
19	**What are the limitations of FDMA-satellite access? (Apr/May 2023)** a. If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient. b. Compared with TDMA, FDMA has less flexibility in reassigning.	
20	**Write about demand assigned TDMA satellite access. (Nov/Dec 2019)** In demand assigned TDMA access, 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.	
21	**Write about pre-assigned TDMA satellite access. (Nov/Dec 2016)** Example for pre-assigned 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 bits. The bit rate is 128 Kb / s.	
22	**Write the two basic problem in satellite digital transmission. (April 2014)** (i)It is difficult to convert incoming analog signal into digital form and then back again. (ii)It is not easy to achieve efficient transmission and reception of digital signals.	

<table>
<tr><td>23</td><td>What is the need of reference burst in TDMA? (May/June 2015) (Apr/May 2021) (Nov/Dec 2022)
The reference bursts are transmitted in each frame. The first reference burst is transmitted by the primary reference station for acquisition and synchronization. Second reference burst is transmitted by the secondary station which is used for synchronization purpose.</td></tr>
<tr><td>24</td><td>Distinguish between pre-assigned and demand assigned traffic (November 2013)
<table>
<tr><th>Pre-assigned</th><th>Demand assigned</th></tr>
<tr><td>Example for pre-assigned 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 bits. The bit rate is 128 Kb / s.</td><td>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.</td></tr>
</table></td></tr>
<tr><td>25</td><td>Draw the curve for transfer characteristics of TDM. (Apr/May 2017)
 

Bandwidth Utilisation of TDM System</td></tr>
<tr><td>26</td><td>Draw the spectrum of baseband voice signal. (Apr/May 2017)
 

Spectrum of Baseband Signal</td></tr>
<tr><td>27</td><td>What is single channel per carrier? Or Define SCPC. (Nov/Dec 2017)/(April/May2018)
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 channel per carrier (SCPC).</td></tr>
<tr><td>28</td><td>List the features of spread spectrum communication (Nov/Dec2018)
The spread spectrum is highly resistant to narrowband interference; difficult to intercept; The code is spread across a wide channel in that case even one bit data cannot give access to the complete information.</td></tr>
<tr><td>29</td><td>How does a CDMA receiver function for the purpose of synchronization maintenance and reliable data reconstruction? (Nov/Dec2018)
A system and method for communicating information signals is by using spread spectrum communication techniques. PN sequences are constructed that provide orthogonally between the users so that mutual interference will be reduced, allowing higher capacity and better link performance. With orthogonal PN codes, the cross-correlation is zero over a predetermined time interval, resulting in no interference between the orthogonal codes, provided only that the code time frames are time aligned with each other.</td></tr>
</table>

<table>
<tr><td>30</td><td colspan="2">Differentiate multiple access from single access. (Apr/May 2018)</td></tr>
<tr><td></td><td>Single access</td><td>Multiple access</td></tr>
<tr><td></td><td>A transponder channel aboard a satellite may be fully loaded by a single transmission from earth station.</td><td>A transponder can be loaded by a number of carriers. These may originate from a number of earth station may transmit one or more of the carriers</td></tr>
<tr><td></td><td>Limited Capacity</td><td>Increase in Capacity</td></tr>
<tr><td>31</td><td colspan="2">What is the use of control bits in the data frame? (Apr/May 2021)
The control field of the data frame consists of 6 bits (of which only the lower 4 are used) that indicate the amount of data in the message.</td></tr>
<tr><td>32</td><td colspan="2">Give the diagrammatic representation of a SPADE system. (Apr/May 2022)
 
</td></tr>
<tr><td>33</td><td colspan="2">What is the function of BCW in a TDMA frame? (Apr/May 22)
Burst code word (BCW) is a binary word, a copy of which is stored at each earth station. By comparing the incoming bits in a burst with the stored version of the BCW, the receiver can detect when a group of received bits matches the BCW, and this in turn provides an accurate time reference for the burst position in the frame.</td></tr>
<tr><td>34</td><td colspan="2">Is Compression and encryption are essential in satellite communication? Justify with examples? (Nov/Dec 2023)
onboard a satellite. Data compression algorithms reduce the size of the data stream by recognizing redundancy in their mathematical representation and then recoding the data for efficient storage and transmission.
Examples:
MPEG-1, MPEG-2</td></tr>
<tr><td>35</td><td colspan="2">List the issues in satellite digital Transmission?
Satellite signals need to travel long distances through space, resulting in transmission delays. This latency can hinder real-time communication and affect services like voice and video conferencing.
Bandwidth limitations: Satellite communication has limited bandwidth compared to terrestrial networks.</td></tr>
<tr><td colspan="3">UNIT-IV / PART-B</td></tr>
<tr><td>1</td><td colspan="2">Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system (13 Marks) (May/June 2015)</td></tr>
<tr><td>2</td><td colspan="2">Explain congestion forward error correction and slow start.</td></tr>
<tr><td>3</td><td colspan="2">Compare the features of the various multiple access schemes deployed for satellite access. Compare the salient features of FDMA, TDMA and CDMA. (13) (A/M 2016) (N/D 2023)</td></tr>
</table>

4	a) Express FDMA in detail and also enumerate the interference in FDMA **(7 Marks)** b**)** Explain direct sequence spread spectrum communication in details. **(6) (N/D 2016)**
5	State the necessity of Digital Modulation in satellite links. With the help of block schematics illustrate the principles of the modulation and demodulation of **BPSK and QPSK** and compare their spectral characteristics and performance in performance of Noise.**(13)(AM22)**
6	Explain in detail about compression and encryption techniques used in satellite communication. **(13 Marks) (Nov/Dec 2022)**
7	Write the design aspects and explain the technical features of TDMA frame structure. **(7 Marks) (Apr/May 2017)**
8	i) Draw the encoder diagram for the following digital signals- Unipolar, NRZ, Polar NRZ, Manchester, Polar RZ for the digital data 1010111. **(10 Marks) (Nov/Dec 2019)** ii) Write down the advantages of CDMA for satellite networking. **(5 Marks) (N/D 2019)**
9	In detail explain about the time division multiplexing and bandwidth requirements in a satellite transmission system. **(13 Marks) (Nov/Dec 2017)**
10	Explain in detail the Code division multiple access technique and lists its advantages. **(13 Marks) (Nov/Dec 2017)**
11	Why CDMA is otherwise called spread spectrum communication? How does it differ from FDMA and TDMA? **(13 Marks) (Nov/Dec 2018)**
12	TDMA is a truly digital technology, requiring that all information be converted into bit streams or data packets before transmission to the satellite. - Justify. **(13 Marks) (N/D 2018)**
13	Explain in detail how carrier recovery is done in TDMA. Describe the concept of multiplexing. What is the advantage of TDMA over FDMA with respect to demand assignment? **(13 Marks) (Apr/May 2018) (Nov/Dec 2019)**
14	(i) Draw the encoder diagram for the following digital signals- Unipolar NRZ, Polar NRZ, Manchester, Polar RZ for the digital data 1010111. **(7 Marks) (Apr/May 2018)** (ii) Explain the principle behind CDMA with a diagram and mention any two advantages of CDMA for satellite networking. **(6 Marks) (Apr/May 2018)**
15	Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network. **(13 Marks) (Nov/Dec 2020) & (April/May 2021)**
16	Briefly describe the ways in which demand assignment may be carried out in an FDMA network. (**5 Marks**) **(Nov/Dec 2020) (Apr/May 2021)**
17	What is the function of: a) the burst-code word and b) the carrier and bit-timing recovery channel in a TDMA burst? **(4 Marks) (Nov/Dec 2020) (Apr/May 2021)**
18	Illustrate the basic equipment blocks in a TDMA system. Sketch the TDMA frame and burst formats and enumerate the functions of each burst. **(13 Marks) (A/M 2022) (A/M 2023)**
19	Briefly describe video compression scheme with a neat block diagram. **(6) (A/M 2022)**
20	Explain frame efficiency of TDMA in detail. In a TDMA network, the reference burst and the preamble require 560 bits each, 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. (**5 Marks**) **(Apr/May 2021) (Apr/May 2022)**
21	Illustrate the channeling scheme in pre assigned FDMA, demand assigned FDMA and SPADE system with suitable example. **(13 Marks)** (**Apr/May 2023)**

22	Explain about the time division multiple access in a satellite transmission System elaborately. **(7 Marks) (Nov/Dec 2022)**
23	Distinguish CDMA and FDMA techniques and explain the CMDA technique in detail. **(6 Marks) (Nov/Dec 2022)**
24	Elucidate about Pre assigned TDMA and Demand Assigned TDMA in detail.**(13) (N/D 23)**

UNIT V SATELLITE APPLICATIONS

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

UNIT-V / PART-A

1	**Give the 3 different types of applications with respect to satellite systems.** 1) The largest international system (Intelsat) 2) The domestic satellite system (Dom sat) in U.S. 3) U.S. National oceanographic and atmospheric administrations (NOAA).
2	**Write the principle behind DTH and GPS. (Apr/May 2016)** Satellites are used to provide the broadcast transmissions It is used to provide direct transmissions into home. The service provided is known as Direct Broadcast Satellite services. Example: Audio, TV and internet services; GPS receivers use a constellation of satellites and ground stations to compute position and time almost anywhere on earth.
3	**List the types of satellite services. (Apr/May 2023)** a. Fixed satellite service b. broadcasting satellite service c. Mobile satellite service d. Navigational satellite services e. Meteorological satellite services.
4	**An intelligent VSAT must use what type of networking to permit the maximum utilization of the satellite capacity? (Apr/May 2016)** An intelligent VSAT uses DAMA (demand assignment multiple access) networking to permit the maximum utilization of the satellite capacity.
6	**What is ECEF?** The geocentric equatorial coordinate system is used with the GPS system. It is called as earth centered, earth fixed coordinate system (ECEF).
7	**Define dilution of precision in GPS? (Nov/Dec 2017)** Position calculations involve range differences and where the ranges are nearly equal; This effect, brought a result of the satellite geometry is defined as dilution of precision.
8	**What is PDOP?** By default, the current Position Dilution of Precision (PDOP) value is shown when the GPS position button is tapped. Dilution of precision, a measure of receiver-satellite geometry quality, uses a scale of 1 to 10. Low numbers indicate better quality.
9	**What is DBS? Name any two services (Nov/Dec 2019)** Satellites are used to provide the broadcast transmissions It is used to provide direct transmissions into home. The service provided is known as Direct Broadcast Satellite services. Example: Audio, TV and internet services.
10	**Give the frequency range of US DBS systems with high power satellites.** a. Uplink frequency range is 17.3 GHz to 17.8 GHz b. Downlink frequency range is 12.2 GHz to 12.7 GHz.
11	**Write about bit rates for digital television.**

	It depends on format of the picture. Uncompressed Bit rate = (Number of pixels in a frame) * (Number of pixels per second) * (Number of bits used to encode each pixel)
12	**Give the satellite mobile services. Or write down the names of any four mobile satellite services. (Apr/May 2018)** a. DBS – Direct Broadcast satellite b. VSATS – Very Small Aperture Terminals c. MSATS – Mobile Satellite Service d. GPS – Global Positioning Systems e. ORBCOMM - Orbital Communications Corporation
13	**What is INMARSAT?** It is the first global mobile satellite communication system operated at Lband and internationally used by 67 countries for communication between ships and coast so that emergency lifesaving may be provided. Also, it provides modern communication services to maritime, land mobile, aeronautical and other users.
14	**List out the regions covered by INMARSAT. (November 2013) (Nov/Dec 2023)** • Atlantic Ocean region, east (AOR-E) • Atlantic Ocean region, west (AOR-W) • Indian ocean region (IOR) • Pacific Ocean region (POR).
15	**What is INSAT?** INSAT – Indian National Satellite System. INSAT is a Indian National Satellite System for telecommunications, broadcasting, meteorology and search and rescue services. It was commissioned in 1983. INSAT was the largest domestic communication system in the Asia-Pacific region.
16	**What is GSM?** GSM (Global System for Mobile communications: originally from Grouped Special Mobile) is the most popular standard for mobile phones in the world. GSM differs from its predecessors in that both signaling, and speech channels are digital, and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system.
17	**What is GPRS?** General packet radio service is a packet oriented mobile data service available to users of the 2G cellular communication systems global system for mobile communications, as well as in the 3G systems. In the 2G systems, GPRS provides data rates of 56-114 Kbit/s.
18	**Define DAB.** DAB - Digital Audio Broadcast. 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.
19	**What is DVB?** DVB - Digital Video Broadcasting Digital Video Broadcasting (DVB) is a set of standards that define digital broadcasting using existing satellite, cable, and terrestrial infrastructures.
20	**What is GRAMSAT? (Nov/Dec 2014) (Nov/Dec 2016) (Nov/Dec 2017) (Apr/May 2023)**

	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.
21	**Write the two areas of satellite communication that are gaining major thrust from leading satellite industry and organizations in recent years. (April 2014)** Very Small Aperture Terminal (VSAT) and Mobile Satellite (MSAT) are the two areas of satellite communication that are gaining major thrust from leading satellite industry and organizations in recent years
22	**Name the services provided by GSM. (May/June 2015)** Telephony services and data services.
23	**Outline the three regions to allocate the frequency for satellite services. (Nov/Dec 2016)** Region 1: it covers Europe, Africa and Magnolia Region 2: It covers North & South America and Greenland Region 3: It covers Asia, Australia and Southwest Pacific.
24	**List the frequency bands assigned for DTH systems. (Apr/May 2017)** 1) Ku band– uplink 14 GHz; downlink 10.9-12.75 GHz 2) Operating frequency of DBS as 11.7-12.5GHz.
25	**List the basic principle of VSAT networks. (Nov/Dec 2018) (Apr/May 2021) (Apr/May 2022)** VSAT (Very Small Aperture Terminal) is a satellite communications system that serves home and business users. A VSAT end user needs a box that interfaces between the user's computer and an outside antenna with a transceiver. The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from an earth station computer that acts as a hub for the system.
26	**In what ways, does a satellite transfer TV signal to the particular consumer? (Nov/Dec 2018)** All signals for television, telephone or internet are converted into radio signals and then sent towards the satellite using a transmitting satellite dish. Most satellite dishes are designed to only receive satellite signals, but some are used to send signals to satellites as well.
27	**Mention the services of INSAT. (Apr/May 2018)** The important services of INSAT are: Television, VSAT, Communication, Tele-education providing education to the poor and needy, Tele-medicine administering medical services from the metros to villages & remote areas.
28	**Write any two features of GPS. (Nov/Dec 2019)** 1. Real time tracking 2. Timing synchronization 3. Navigation assistance 4.Geotagging
29	**What is the difference between active and passive satellites? (Apr/May 2021)** Active satellites are a complicated structure having processing equipment called Transponder. A passive satellite only reflects received signals back to earth.

<table>
<tr><td>30</td><td>Define MEO (Nov/Dec 2022)
A medium Earth orbit is an Earth-centered orbit with an altitude above a low Earth orbit and below a high Earth orbit – between 2,000 and 35,786 km above sea level.</td></tr>
<tr><td>31</td><td>Compare LEO and MEO satellites in terms of height, orbital period and propagation loss. (Apr/May 2022)
<table>
<tr><th>Parameter</th><th>LEO</th><th>MEO</th><th>GEO</th></tr>
<tr><td>Satellite Height</td><td>500-1500 km</td><td>5000-12000 km</td><td>35,800km</td></tr>
<tr><td>Orbital Period</td><td>10-40 min</td><td>2-8 hours</td><td>24 hours</td></tr>
<tr><td>Propagation Loss</td><td>Least</td><td>High</td><td>Highest</td></tr>
</table></td></tr>
<tr><td>32</td><td>What are the uses of Satellite Navigational System? (Nov/Dec 2022)
• Road and Rail navigation.
• Logistics and shipping services.
• Marine application.
• Military and commercial aviation.
• Precision agriculture.
• Drone Operation</td></tr>
<tr><td>33</td><td>Mention a few applications supported by INTELSAT and INSAT series. (N/D 2023)
International Telecommunications Satellite Organization, or Intelsat, is created to own and manage a constellation of communications satellites providing international broadcast services. It provides services to telephone & television broadcasting,
The INSAT system with more than 200 transponders in the C, Extended C and Ku-bands provides services to telecommunications, television broadcasting, satellite newsgathering, societal applications, weather forecasting, disaster warning and Search and Rescue operations.</td></tr>
<tr><td colspan="2">UNIT-V / PART-B</td></tr>
<tr><td>1</td><td>Describe the operation of typical VSAT system. State briefly where VSAT system find widest application. (13 Marks) (May/June 2015) (Nov/Dec 2022) (Apr/May 2023)</td></tr>
<tr><td>2</td><td>Describe the main features and service offered by INTELSAT satellite systems. How do these services compare with services offered by other satellites used for communication? (13) (April/May 2023)</td></tr>
<tr><td>3</td><td>Discuss on INMARSAT and VSAT services in detail. (13 Marks) (Apr/May 2022)</td></tr>
<tr><td>4</td><td>With the help of Block Diagram and explain the operation of INMARSAT. (13) (A/M 2023)</td></tr>
<tr><td>5</td><td>Explain about LEO, MEO & GEO. (5 Marks) (Nov 2013)</td></tr>
<tr><td>6</td><td>i) With block diagram explain the working principle of DBS-TV receiving system.
ii) Write an overview on VSAT systems. (Apr/May 2021) (Apr/May 2022)</td></tr>
<tr><td>7</td><td>Explain the characteristics of a typical VSAT system and key components for a VSAT network. (8 Marks) (Nov/Dec 2020) (April/May 2021)</td></tr>
<tr><td>8</td><td>Compare LEO and MEO satellite? What are the advantage and disadvantage and application of LEO and MEO satellite? (5 Marks) (Nov/Dec 2020) (April/May 2021)</td></tr>
<tr><td>9</td><td>(i) Explain the working of Global Positioning System? (8)) (N/D 2020) (Apr/May 2021)
(ii) Explain the features of Direct to Home Broadcasting Satellite. (5) (Apr/May 2021)</td></tr>
<tr><td>10</td><td>How mobile services are used in satellite communication systems? (13 Marks) (N/D 2018)</td></tr>
<tr><td>11</td><td>Write the features of digital TV broadcast. List the various factors of home receiver unit. (13 Marks) (Nov/Dec 2018) (Nov/Dec 2022).</td></tr>
</table>

12	(i) Explain the concept behind DTH. **(7 Marks)** (ii) Write in detail about the features of GPS. **(6 Marks) (Apr/May 2018) (Apr/May 2023)**
13	Explain the architecture of GSM in detail. **(13 Marks) (Apr/May 2022)**
14	(i)Explain the three segments of a GPS. Also, describe how position and ranging are determined using a GPS system. **(7 Marks)** (ii)Write short notes on GSM architecture. **(6 Marks)**
15	Explain in detail about GPS Position Location Principles **(13 Marks)**
16	Explain in detail about Differential GPS **(13 Marks)**
17	Write a short notes on Satellite Navigational System **(5 Marks)**

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