**STEP MATERIAL**

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| **Satellite Communication** |  |
|  | **UNIT – I** |
| 1. What is Satellite? | **SATELLITE ORBITS** |
|  |

An artificial body that is projected from earth to orbit either earth (or) another body of solar systems.

Types: Information satellites and Communication Satellites 2. Define Satellite Communication.

It is defined as the use of orbiting satellites to receive, amplify and retransmit data to earth stations.

3. State Kepler’s first law.

It states that the path followed by the satellite around the primary will be an ellipse.

An ellipse has two focal points F1 and F2. The center of mass of the two body system,

termed the barycenter is always centered on one of the foci.

e = [square root of (a2– b2) ] / a

4. State Kepler’s second law.

It states that for equal time intervals, the satellite will sweep out equal areas in its orbital plane, focused at the barycenter

.

5. State Kepler’s third law.

It states that the square of the periodic time of orbit is perpendicular to the cube of the mean distance between the two bodies.



Where, n = Mean motion of the satellite in rad/sec.

µ= Earth’s geocentric gravitational constant. With the n in radians per sec. the orbital period in second is given by,



6. Define apogee.

The point farthest from the earth.

7. Define Perigee.

The point closest from the earth.

8. What is line of apsides?

The line joining the perigee and apogee through the center of the earth.

9. Define ascending node.

north. The point where the orbit crosses the equatorial plane going from south to

10. Define descending node.

south. The point where the orbit crosses the equatorial plane going from north to

11. Define Inclination.

The angle between the orbital plane and the earth’s equatorial plane. It is measured at the ascending node from the equator to the orbit going from east to north.

12. Define mean anomaly.

It gives an average b value of the angular position of the satellite with reference to the perigee.

13. Define true anomaly.

It is the angle from perigee to the satellite position, measured at the earth’s center.

15. What is meant by azimuth angle?

It is defined as the angle produced by intersection of local horizontal plane and the plane passing through the earth station, the satellite and center of earth.

1. Give the 3 different types of applications with respect to satellite systems.
   * The largest international system (Intelsat)
   * The domestic satellite system (Dom sat) in U.S.
   * U.S. National oceanographic and atmospheric administration’s (NOAA)
2. Mention the 3 regions to allocate the frequency for satellite services.
   * Region1: It covers Europe, Africa and Mangolia
   * Region2: It covers North & South Ameriaca and Greenland.
   * Region3: It covers Asia, Australia and South West Pacific.
3. Give the types of satellite services.
   * Fixed satellite service
   * Broadcasting satellite service
   * Mobile satellite service
   * Navigational satellite services
   * Meteorological satellite services
4. What is mean by Dom sat?

Domestic Satellites. These are used for voice, data and video transmissions within the country.

1. What is mean by INTELSAT & SARSAT ?
   * International Telecommunication Satellite.
   * Search and rescue satellite.
2. Define polar-orbiting satellites.

Polar orbiting satellites orbit the earth in such a way as to cover the north and south polar regions.

22. Give the advantage of geostationary orbit.

There is no necessity for tracking antennas to find the satellite positions.

23. Define look angles.

The azimuth and elevation angles of the ground station antenna are termed as look angles.

24. Write short notes on station keeping.

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.

25. What are the geostationary satellites?

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.

26. What is sun transit outage.

The sun transit is nothing but the sun comes within the beam width of the earth station antenna. During this period the sun behaves like an extremely noisy source and it blanks out all the signal from the satellite. This effect is termed as sun transit outage.

**UNIT – II**

**SPACE SEGMENT AND LINK DESIGN**

1. Give the two segments of basic satellite communication.

a. Earth segment (or) ground segment

b. Space segment

2. Write short notes on attitude 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. What is declination?

The angle of tilt is often referred to as the declination which must not be confused with the magnetic declination used in correcting compass readings.

4. What is meant by payload?

It refers to the equipment used to provide the service for which the satellite has been launched.

5. What is meant by transponder?

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.

6. Write short notes on station keeping.

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.

7. What is meant by Pitch angle?

Movement of a spacecraft about an axis which is perpendicular to its longitudinal axis. It is the degree of elevation or depression.

8. What is an propellant?

thrust.A solid or liquid substance burnt in a rocket for the purpose of producing

9. What is an Yaw?

Yaw is the rotation of a vehicle about its vertical axis.

10. What is an zero ‘g’?

Zero ‘g’ is a state when the gravitational attraction is opposed by equal and opposite inertial forces and the body experiences no mechanical stress.

11. Describe the spin stabilized satellites.

In a spin stabilized satellites, the body of the satellite spins at about 30 to 100 rpm about the axis perpendicular to the orbital plane. The satellites arem 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.

12. What is meant by frequency reuse?

The carrier with opposite senses of polarization may overlap in frequency.

This technique is known as frequency reuse.

13. What is meant by spot beam antenna?

A beam generated by a communication satellite antenna of sufficient size that the angular spread of sufficient size that the angular spread of the energy in the beam is very small with the result that a region that is only a few hundred km in diameter is illuminated on earth.

14. 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.

15. What is polarization interleaving?

Overlap occurs between channels, but these are alternatively polarized left hand circular and right hand circular to reduce interference to acceptable levels. This is referred to as polarization interleaving.

16. Define S/N ratio.

The S/N introduced in the preceding section is used to refer to the ratio of signal power to noise power at the receiver output. This is known as S/N ratio.

17. What is an intermodulation noise?

Intermodulation distortion in high power amplifier can result in signal product which appear as noise and it is referred to as intermodulation noise.

18. What is an antenna loss?

It is added to noise received as radiation and the total antenna noise temperature is the sum of the equivalent noise temperature of all these sources.

19. Define sky noise.

It 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.

20. Define noise factor.

An alternative way of representing amplifier noise is by means of its noise factor. In

defining the noise factor of an amplifiers, usually taken as 290 k.

21. 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 transtube and its power supplies.

22.What is meant by thermal control and why this is necessary in a satellite?

Equipment in the satellite generates heat which has to be removed. The element used in the satellite to control thermal heat is called thermal conrol. The most important consideration is that the satellite’s equipment should operate as nearly as possible in a stable temperature environment

23.What are the functions carried out in TT&C?

Telemetry- *Gathering or measure information about satellite*.

Tracking- track the satellite’s movement and send correction signals as Required Comment- send information about the satellite to earth station.

24.What is meant by redundant receiver?

A duplicate receiver is provided so that if one fails, the other is automatically switched in. The combination is referred to as a *redundant receiver*, meaning that although two are provided, only one is in use at a given time.

25.List out the advantages of TWT.

The advantage of the TWT over other types of tube amplifiers is that it can provide amplification over a very wide bandwidth. Input levels to the TWT must be carefully controlled, however, to minimize the effects of certain forms of distortion

26.Define input back off.

In a TWTA, the operating point must be backed off to a linear portion of the transfer characteristic to reduce the effects of intermodulation distortion.The point from the saturation point to linear region at the input is called input backoff.

27.Define diplexer & *orthocoupler.*

The same feed horn may be used to transmit and receive carriers with the same polarization. The transmit and receive signals are separated in a device known as a *diplexer*,

The polarization separation takes place in a device known as an *orthocoupler*, or *orthogonal mode transducer* (OMT). Separate horns also may beused for the transmit and receive functions, with both horns using the same reflector.

**UNIT – III**

**SATELLITE ACCESS**

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.

1. What are the methods of multiple access techniques?

FDMA – Frequency Division Multiple Access Techniques TDMA – Time Division Multiple Access Techniques

* 1. What is an CDMA?

CDMA – 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 SCPC?

SCPC means Single Channel Per Carrier. 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.

6. What is a thin route service?

SCPC systems are widely used on lightly loaded routes, this type of service being referred to as a thin route service.

7. What is an important feature of Intelsat SCPC system?

The system is that each channel is voice activated. This means that on a two way telephone conversation only one carriers is operative at any one time.

8. What is an TDMA? What are the advantages?

TDMA – Time Division Multiple Access Techniques

Only one carrier uses the transponder at any one time, and therefore Inter modulation products, which results from the non -linear amplification of multiple carriers are absent. Advantages : The transponder traveling wave tube can be operated at maximum power output.

9. 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.

10. 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.

11. 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. This is known as decoding quenching.

12. What is meant by direct closed loop feedback?

The timing positions are reckoned from the last bit of the unique word in the preamble. The loop method is also known as direct closed loop feedback.

13. What is meant by feedback closed loop control?

The synchronization information is transmitted back to an earth station from a distant, that is termed feedback closed loop control.

14. Define frame efficiency.

traffic.It is measure of the fraction of frame time used for the transmission of

15. What is meant by digital speech interpolation?

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

16. What is meant by telephone load activity factor?

The fraction of time a transmission channel is active is known as the telephone load activity factor.

17. What are the types of digital speech interpolation?

• Digital time assignment speech interpolation

• Speech predictive encoded communications

18. What is meant by freeze out?

It has assumed that a free satellite channel will be found for any incoming speed spurt, but there is a finite probability that all channels will be occupied and the speech spurt lost. Losing a speech spurt in this manner is referred to as freeze out.

19. What are the advantages of SPEC method over DSI method?

Freeze out does not occur during overload conditions.

20. Define satellite switched TDMA?

Space Division Multiplexing can be realized by switching the antenna interconnections in synchronism with the TDMA frame rate, this being known as satellite switched TDMA.

21. What is SS / TDMA?

A repetitive sequence of satellite switch modes, also referred to as SS /TDMA.

22. What is processing gain?

The jamming or interference signal energy is reduced by a factor known as the processing gain.

23. What is burst code word?

It is a binary word, a copy of which is stored at each earth station.

24. What is meant by 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.

25. What is an single access?

A transponder channel aboard a satellite may be fully loaded by a single transmission from earth station.

26. What is an multiple access technique?

A transponder to 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 known as multiple access technique.

27. 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..

1. What are the limitations of FDMA-satellite access?
   1. If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient.
   2. Compared with TDMA, FDMA has less flexibility in reassigning

channels.

* 1. Carrier frequency assignments are hardware controlled..

1. Write about pre-assigned TDMA satellite access.

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.

30. Write about demand assigned TDMA satellite 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.

**UNIT – IV**

**EARTH SEGMENT**

1. Define earth segment.

Earth segment of a satellite communication system consists of transmit earth station and receive earth station.

Example : TV Receive Only systems (TVRO systems)

2. Give the difference between KU-band and the C-band receive only systems.

Operating frequency of outdoor unit.

3. What is mean by ODU and IDU.

ODU – The Home Receiver Outdoor Unit

IDU – The Home Receiver Indoor Unit

4. Explain about MATV system.

MATV – Master Antenna TV system.

It is used to provide reception of DBS TV channels to the user group. Example : Apartment users It consists of one outdoor unit and various indoor units. Each user can independently access all the channels.

5. Write about CATV system.

CATV – Community Antenna TV system.

As in MATV system, it consists of oneoutdoor unit and separate feeds for each sense of polarization.

6. Define S/N ratio.

The S/N introduced in the preceding section is used to refer to the ratio of signal power to noise power at the receiver output. This is known as S/N ratio.

7. What is noise weighting?

The method used to improve the post detection signal to noise ratio is referred to as noise weighting.

8. What is an EIRP?

EIRP means Equivalent Isotropic Radiated Power. It is a measure of radiated or

transmitted power of an antenna.

9. What is noise power spectral density?

Noise power per unit Bandwidth is termed as the noise power spectral density.

10. What is an inter modulation noise?

Inter modulation distortion in high power amplifier can result in signal product which appear as noise and it is referred to as inter modulation noise.

11. What is an antenna loss?

It is added to noise received as radiation and the total antenna noise temperature is the sum of the equivalent noise temperature of all these sources.

12. Define noise factor.

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defining the noise factor of an amplifiers, usually taken as 290 k.

1. 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.

EIRP = 10 log 6 + 48.2 = 56 dBW

1. 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 15. Define Saturation flux density.

The flux density required at the receiving antenna to produce saturation of TWTA is termed the saturation flux density.

**UNIT – V**

**SATELLITE APPLICATIONS**

1. Give the 3 different types of applications with respect to satellite systems.
   * The largest international system (Intelsat)
   * The domestic satellite system (Dom sat) in U.S.
   * U.S. National oceanographic and atmospheric administrations (NOAA)
2. Mention the 3 regions to allocate the frequency for satellite services.

a. Region1: It covers Europe, Africa and Mangolia

b. Region2: It covers North & South Ameriaca and Greenland.

c. Region3: It covers Asia, Australia and South West Pacific.

1. Give the types of satellite services.
   1. Fixed satellite service
   2. Broadcasting satellite service
   3. Mobile satellite service
   4. Navigational satellite services
   5. Meteorological satellite services
2. What is mean by Dom sat?

Domestic Satellites. These are used for voice, data and video transmissions within the country.

5. What is mean by INTELSAT?

International Telecommunication Satellite.

6. What is mean by SARSAT?

Search and rescue satellite.

7. What are the applications of Radarsat?

a. Shipping and fisheries.

b. Ocean feature mapping

d. Iceberg detection

e. Crop monitoring

8. What is ECEF?

The geocentric equatorial coordinate system is used with the GPS system.It is called as earth centered, earth fixed coordinate system.

9. What is dilution of precision?

Position calculations involve range differences and where the ranges are nearly equal, any error is greatly magnified in the difference. This effect, brought a result of the satellite geometry is known as dilution of precision.

10. What is PDOP?

With the GPS system, dilution of position is taken into account through a factor known as the position dilution of precision.

11. What is DBS?

Satellites are used to provide the broadcast transmissions. It is used to provide direct transmissions into the home. The service provided is known as Direct Broadcast Satellite services.

Example : Audio, TV and internet services.

12. 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

13. Give the frequency range of US DBS systems with medium power satellites. a. Uplink frequency range is 14 GHz to 14.5 GHz

b. Downlink frequency range is 11.7 GHz to 12.2 GHz

14. What is DTH?

DBS television is also known as Direct To Home ( 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.

DTH Broadcasting to home TV receivers take place in the ku band(12 GHz).

This service is known as Direct To Home service.

15. Write about bit rates for digital television.

It depends 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)

1. Give the satellite mobile services.
   1. DBS – Direct Broadcast satellite
   2. VSATS – Very Small Aperture Terminals
   3. MSATS – Mobile Satellite Service
   4. GPS – Global Positioning Systems
   5. Micro Sats
   6. Orb Comm – Orbital Communications Corporation
   7. Iridium
2. What is GCC and GEC?

GCC - Gateway Control Centers

GEC – Gateway Earth Stations

18. 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 life saving may be provided. Also it provides modern communication services to maritime, land mobile, aeronautical and other users.

1. List out the regions covered by INMARSAT.
   * Atlantic ocean region, east (AOR-E)
   * Atlantic ocean region, west (AOR-W)
   * Indian ocean region (IOR)\• Pacific ocean region (POR)

20.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.

1. List out the INSAT series.
   * INSAT -1 • INSAT-2 • INSAt-2A
   * INSAT-2E • INSAT-3

21.What is GSM?

GSM (Global System for Mobile communications: originally from Groupe Spécial 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.

22.What is GPRS?

General packet radio service (GPRS) is a packet oriented mobile data service available to users of the 2G cellular communication systems global system for mobile communications (GSM), as well as in the 3G systems. In the 2G systems, GPRS provides data rates of 56 -114 kbit/s.

23. What is GPS?

In the GPS system, a constellation of 24 satellites circles the earth in near-circular inclined orbits. By receiving signals from at least four of these satellites, the receiver position (latitude, longitude, and altitude) can be determined accurately. In effect, the satellites substitute for the geodetic position markers used in terrestrial surveying. In terrestrial the GPS system uses one-way transmissions, from satellites to users, so that the user does not require a transmitter, only a GPS receiver.