JEPPIAAR

ENGINEERING COLLEGE

JEPPIAAR NAGAR, CHENNAI – 600119

Department of Electronics & Communication Engineering

QUESTION BANK

V SEMESTER

CEC352 – SATELLITE COMMUNICATION

Regulation – 2021(Batch: 2022-2026)

Academic Year: 2024 – 25

JEPPIAAR ENGINEERING COLLEGE		
Vision of the Institute	To build Jeppiaar Engineering College as an institution of academic excellence in technological and management education to become a world class University	
Mission of the Institute	**M1**	To excel in teaching and learning, research and innovation by promoting the principles of scientific analysis and creative thinking
	M2	To participate in the production, development and dissemination of knowledge and interact with national and international communities.
	M3	To equip students with values, ethics and life skills needed to enrich their lives and enable them to meaningfully contribute to the progress of society
	M4	To prepare students for higher studies and lifelong learning, enrich them with the practical and entrepreneurial skills necessary to excel as future professionals and contribute to Nation's economy
DEPARTMENT: ELECTRONICS AND COMMUNICATION ENGINEERING		
Vision of the Department	To become a centre of excellence to provide quality education and produce creative engineers in the field of Electronics and Communication Engineering to excel at international level.	
Mission of the Department	**M1**	Inculcate creative thinking and zeal for research to excel in teaching-learning process
	M2	Create and disseminate technical knowledge in collaboration with industries
	M3	Provide ethical and value based education by promoting activities for the betterment of the society
	M4	Encourage higher studies, employability skills, entrepreneurship and research to produce efficient professionals thereby adding value to the nation's economy

PROGRAM OUTCOMES (PO)	**PO 1**	**Engineering knowledge**: **Apply** the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
	PO 2	**Problem analysis**: **Identify, formulate, review** research literature, and **analyze** complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
	PO 3	**Design/development of solutions**: **Design solutions** for complex engineering problems and **design** system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
	PO 4	**Conduct investigations of complex problems**: **Use** research-based knowledge and research methods including **design** of experiments, **analysis** and **interpretation** of data, and **synthesis** of the information to provide valid conclusions.
	PO 5	**Modern tool usage**: **Create**, **select**, and **apply** appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
	PO 6	**The engineer and society**: **Apply** reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO 7	**Environment and sustainability**: **Understand** the impact of the professional engineering solutions in societal and environmental contexts, and **demonstrate** the knowledge of, and need for sustainable development.
	PO 8	**Ethics**: **Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
	PO 9	**Individual and team work**: **Function effectively** as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
	PO 10	**Communication**: **Communicate effectively** on complex engineering activities with the engineering community and with society at large, such as, being able **to comprehend** and **write** effective reports and **design** documentation, **make** effective presentations, and **give** and **receive** clear instructions.
	PO 11	**Project management and finance**: **Demonstrate** knowledge and understanding of the engineering and management principles and **apply** these to one's own work, as a member and leader in a team, to **manage** projects and in multidisciplinary environments.
	PO 12	**Life-long learning**: **Recognize** the need for, and have the preparation and ability to **engage** in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)	**PEO I**	Produce technically competent graduates with a solid foundation in the field of Electronics and Communication Engineering with the ability to analyze, design, develop, and implement electronic systems.
	PEO II	Motivate the students for choosing the successful career choices in both public and private sectors by imparting professional development activities.
	PEO III	Inculcate the ethical values, effective communication skills and develop the ability to integrate engineering skills to broader social needs to the students.
	PEO IV	Impart professional competence, desire for lifelong learning and leadership skills in the field of Electronics and Communication Engineering.
PROGRAM SPECIFIC OUTCOMES (PSOs)	**PSO 1**	Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles.
	PSO 2	Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.
	PSO 3	Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems.

CEC352 SATELLITE COMMUNICATION L T P C
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OBJECTIVES: The student should be made to:

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Analyze the various methods of satellite access
- Understand the applications of satellites
- Understand the basics of satellite Networks

UNIT I SATELLITE ORBITS 9

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 II SPACE SEGMENT 9

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 III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING METHODS 9

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 V SATELLITE APPLICATIONS 9

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).

TOTAL:45 PERIODS

OUTCOMES: At the end of the course, the student would be able to:

- Analyze the satellite orbits
- Analyze the earth segment and space segment
- Analyze the satellite Link design
- Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, ―Satellite Communication‖, 4th Edition, Mc Graw Hill International, 2006.
2.Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication‖,2nd Edition, Wiley Publications,2002

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, ―Satellite Communication Systems Engineering‖, Prentice Hall/Pearson, 2007.
2. N.Agarwal, ―Design of Geosynchronous Space Craft‖, Prentice Hall, 1986.
3. Bruce R. Elbert, ―The Satellite Communication Applications‖, Hand Book, Artech House Bostan London, 1997.
4. Tri T. Ha, ―Digital Satellite Communication‖, II nd edition, 1990.
5. Emanuel Fthenakis, ―Manual of Satellite Communications‖, Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, ―Telecommunication Trans Mission Systems‖, Mc Graw-Hill Book Co., 1983.
7. Brian Ackroyd, ―World Satellite Communication and earth station Design‖, BSP professional Books, 1990.
8. G.B.Bleazard, ―Introducing Satellite communications―, NCC Publication, 1985. 9. M.Richharia, ―Satellite Communication Systems-Design Principles‖, Macmillan 2003.

UNIT I- SATELLITE ORBITS

PART A (2 Mark Questions)

1. What are the different applications of satellite systems?

*Largest International System(Intel sat)

*Domestic sat system in united states(Dom sat)

*U.S National Oceanography Atmospheric Administration (NOAA)

2. Mention the different services of satellite systems.

*Fixed satellite services

*Broadcasting satellite services

*Mobile satellite services

*Navigational satellite services

*Meteorological satellite services.

3. Define Polar-orbiting Satellites.

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

4. 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 &F2.The center of mass of the two body system, termed the barycenter is always centered on one of the foci.

$$E = \sqrt{a^2 - b^2}/a$$

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5. StateKepler 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.

6. State kepler s third law. NOV 2018

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

$$a^3 = \mu/n^2$$

7. Define apogee & perigee.

*The point farthest from the earth is known as apogee.

*The point closest from the earth is known as perigee.

8. What is line of apsides?

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

9. Define ascending & descending node.

The point where the orbit crosses the equatorial plane going from South North.

10. Define inclination.

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

11. Define mean anomaly & true anomaly .

Mean anomaly: It gives an average value of the angular position of the satellite with reference to the'perigee.

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

12. Mention the apogee &perigee height. APRIL2021

Ra = a (1+e)

Rp = a (1+e)
Ha = ra-Rp
Hp =rp-Rp

13. Define Universal time. NOV 2018

It is the time used for all civil time keeping purposes & it is the time reference which is broadcast by the national bureau of standards as a standard for setting clocks.

$$UT\ day = 1/24(hours+minutes/60+seconds/3600)$$
$$UT^{o} = 360\ X\ UT\ day.$$

14. Mention the julian dates.

JD = JD010 + day number + Utday

15. What is sideral time?

Sideral time is time measured relative to the fixed stars. It will be seen that one complete rotation sideral time relative to the sun .This is because the earth moves in its orbit around the sun.

16. Define Sideral day.

It is defined as one complete rotation of the earth relative to the fixed stars. It is measured as 23h56m04s mean solar time.

17. Define Greenwich hour angle (GHA).

The angular distance from the I axis to the Greenwich meridian is measured directly as Greenwich sideral time ,also known as the Greenwich hour angle.

18. Write the formula for GST.

GST = 99.6910+ 36000.7689Xt +0.0004Xt +2+UT deg

19. Define geocentric latitude.

$$\text{As a point of interest for zero height, the angle } \Psi e\ (h=0) = (1-Ee^{2})\tan\lambda E$$

20. What are the differences between the geodetic & geocentric latitudes?

The latitudes reaches a maximum at a geocentric latitude of 45deg, when the geodetic latitude is 45.192deg.

21. What is satellite?

An artificial body that is projected from earth to orbit either earth (or) another body of solar systems. Types: Information satellites and Communication Satellites

22. Define Satellite Communication.

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

23. 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.

24. 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.

25. Define look angles.

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

26. 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.

27. Given the geoststionary orbital radius r the earth radius R and speed or light c how will you compute the time taken for a signal to pass from earth to the satellite and back again?

Example 2.1 Calculate the radius of a circular orbit for which the period is 1 day.

Solution There are 86,400 seconds in 1 day, and therefore the mean motion is

2

$$n = \frac{2\pi}{86400}$$

$$= 7.272 \times 10^{-5} \text{ rad/s}$$

They are:

1	Semimajor axis 'a'	}	These two give the shape of the ellipse
2	Eccentricity 'e'		
3	Mean anomaly 'Mo'	-	This gives the position of the satellite in its orbit at a reference time known as the ***epoch.***
4	Argument of perigee 'ω'	-	This gives the rotation of the orbit's perigee point relative to the orbits line of nodes in the earth's equatorial plane.
5	Inclination '*i*'	}	These two relate the orbital plane's position to the earth
6	Right ascension of the ascending node 'Ω'		

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

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

30. What do you understand by Hohmann Transfer?
While launching satellites in orbits greater than 200 km it is not economical in terms of launch power to perform direct injection, and satellite must be placed into transfer orbit between the

initial low earth orbit and the final high altitude orbit. In most of the cases, the transfer orbit is selected to minimize the energy required for transfer and such and orbit is known as Hohmann Transfer Orbit.

31. Write short notes on station keeping. APRIL 2022

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

32. 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.

33. Define look angles.

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

34. Give the 3 different types of applications with respect to satellite systems. APRIL 2023

• The largest international system (Intelsat)
• The domestic satellite system (Dom sat) in U.S.
• U.S. National oceanographic and atmospheric administration's (NOAA)

35. 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.

36. Give the types of satellite services.

• Fixed satellite service
• Broadcasting satellite service
• Mobile satellite service
• Navigational satellite services
• Meteorological satellite services

37. What is mean by Dom sat?APRIL 2022

Domestic Satellites. These are used for voice, data and video transmissions within the country. These are launched by GSLV vehicles. They are designed in a manner to continuously monitor the region.

38. What is mean by INTELSAT?

International Telecommunication Satellite. It's a constellation of 17 satellites from U.S and European union. It serves as basis for GPS coordinates all over the world.

39. What is mean by SARSAT?

Search and rescue satellite. They are kind of remote sensing satellites, are useful to find the particular location during catastrophe periods.

40. Define polar-orbiting satellites. APRIL 2023

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

41. Give the advantage of geostationary orbit.

There is no necessity for tracking antennas to find the satellite positions. They are able to monitor the particular place continuously without the necessity in change of coordinates.

42. What is Satellite? Mention the types.

An artificial body that is projected from earth to orbit either earth (or) another body of solar systems. Types: Information satellites and Communication Satellites

43. Define 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

44. Define 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.

45. Define 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. www.Vidyarthiplus.com www.Vidyarthiplus.com a3= 3 / n2 Where, n = Mean motion of the satellite in rad/sec. 3 = Earth's geocentric gravitational constant. With the n in radians per sec. the orbital period in second is given by,P = 27 / n

46. 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.

47. Define Orbital elements OR Assume a circular orbit : Using Newton's law of gravitation and Newton's second law, determine the acceleration of a satellite. APRIL2021

Orbital elements are the parameters required to uniquely identify a specific orbit. In celestial mechanics these elements are generally considered in classical two-body systems, where a Kepler orbit is used (derived from Newton's laws of motion and Newton's law of universal gravitation). There are many different ways to mathematically describe the same orbit, but certain schemes each consisting of a set of six parameters are commonly used in astronomy and orbital mechanics.

48. Define the shape and size of the ellipse APRIL 2022

Eccentricity (e) - shape of the ellipse, describing how flattened it is compared with a circle. (not marked in diagram)

Semi major axis (a) - the sum of the periapsis and apoapsis distances divided by two. For circular orbits the semi major axis is the distance between the bodies, not the distance of the bodies to the center of mass.

49. Write short notes on Atmospheric drag.

Drag (sometimes called air resistance or fluid resistance) refers to forces that oppose the relative motion of an object through a fluid (a liquid or gas). Drag forces act in a direction opposite to the oncoming flow velocity. Unlike other resistive forces such as dry friction, which is nearly independent of velocity, drag forces depend on velocity.

50. Write short notes on Ku band

The Ku band (Kurtz-under band) is primarily used for satellite communications, particularly for editing and broadcasting satellite television. This band is split into multiple segments broken down into geographical regions, as determined by the ITU (International Telecommunication Union). The Ku band is a portion of the electromagnetic spectrum in the microwave range of frequencies ranging from 11.7 to 12.7GHz. (downlink frequencies) and 14 to 14.5GHz (uplink frequencies).

51. Given A satellite is in an orbit with a perigee of 1000 km and an apogee of 4000 km. Using a mean earth radius of 6378.14 km, find the period of the orbit in hours, minutes, and seconds APRIL2021

Apogee height = h a
Perigee height = h p
r a = h a + R
= 4000 + 6378.14
= 10378. 14 km
r p = h p + R
= 1000 + 6378.14
= 7378.14 km
We get a = r a + r p
a = 17,756.28

Now T = √4π^2 a^3 / G M

G = 6.672 x 10^-11 m^3/kg/s^2

M = 5974 x 1024 kg

So T = 8320.95 secs

T = 2 hrs 19 min 8 secs

PART-B

1. i)Explain the orbital plane. Draw it neat sketch

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 16-17

ii) Explain how keplers law and newton's law used to describe an orbit APRIL 2022

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 21-23

2. Explain the Orbital perturbations.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 30-35

●i) Explain the geocentric equatorial &top centric co-ordinate system. APRIL 2022

●Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 46,53

ii) Explain the sub satellite point

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 57

3. i)A satellite is orbiting the equatorial plane with a period from perigee to perigee of 10 h. given that the eccentricity is 0.002 and the earth's equatorial radius is 6378.1414 km how will you calculate the major axis? NOV 2018

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 62

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

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 68,60

4. Give a detailed note on launching Vehicles and the procedures employed for launching spacecraft in GEO orbits NOV 2018

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 83

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

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 77,86

ii) Discuss about launching procedure.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 83

6. Explain about various frequencies used for satellite Communication.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 65

7. Briefly present the overview of Indian satellites. APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 93

8. Explain about equatorial coordinate and geocentric coordinate system.APRIL2021

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 85

9. Explain about sidereal time in detail.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 74

10. Write short notes on Julian day and dates

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 78

11. Write short notes on Atmospheric drag.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 88

12. Explain about various Orbital elements in detail

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 90

13. Explain about kepler laws in detail APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 95

14. Summarize how you will determine the look angles for the geo-stationary orbit? What

are known as sun-synchronous orbits.APRIL 2021
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 83

UNIT-II SPACE SEGMENT AND SATELLITE LINK DESIGN

PART-A

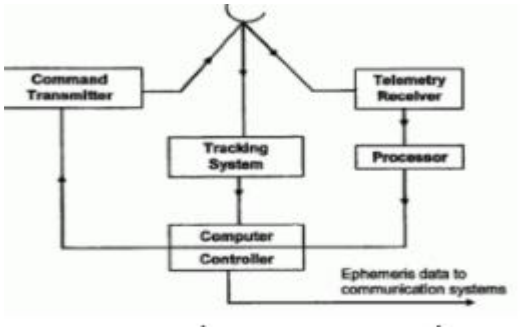
1. What is meant by azimuth angle? NOV 2018
It is defined as the angle produced by intersection of local horizontal plane & the plane passing through the earth station ,the satellite & center of earth.

2. What are the conditions of location of the earth station & sub satellite point of the Azimuth angle? APRIL 2022

For ES in northern hemisphere:
A=180deg-A' (ES west of satellite)
A=180deg+A' (ES east of satellite)
For ES in northern hemisphere:
A= A' (ES west of satellite)
A= 360- A' (ES east of satellite)
$A'=\tan^{-1}(\tan(\theta s-\theta l)/\sin\theta l$.

3. Write short notes on attitude control system.
It is the system that achieves & maintains the required attitudes. The main functions of attitude control system include maintaining accurate satellite position throughout the life span of the system.
4. What is an polar antenna?
A single actuator is used which moves the antenna in a circular arc ie known as polar mount antenna.
5. 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.
6. Define the terms in Eclipse.
During equinox periods, the earth the sun & the satellite are in alignment with the result that earth s'shadow eclipses the satellite & the sunlight fails to reach the satellite solar cells. The eclipse effect is noticeable for periods of about four weeks & the maximum daily eclipse duration is about 1.20hours.
7. What is meant by payload? APRIL2021
The payload refers to the equipment used to provide the service for which the satellite has been launched.
8. What is meant by'transponder? APRIL2021 APRIL 2022
In a communication satellite, the equipment which provides the connecting link between the satellite s transmit& receive antennas is referred to as the transponder.
9. 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 initially placed in the correct orbit, natural forces induce a progressive drift.
10. What is mean by Pitch angle?
Movement of a spacecraft about an axis which is perpendicular to its longitudinal axis. It is the deg of elevation or depression.

11. What is an propellant?
A solid or liquid substance burnt in a rocket for the purpose of producing thrust.
12. What is an Yaw?
Yaw is the rotation‘ ’of a vehicle about its vertical axis.
13. ‘ ’What is an Zero g ?
Zero g is a state when the gravitational attraction is opposed by equal & opposite inertial forces & the body experiences no mechanical stress.
14. Describe the spin stabilized satellites. APRIL 2023
In a, spin stabilized satellites, the body of the satellite spins at about 30 to 100rpm about the axis perpendicular to the orbital plane. The satellites are normally dual spin satellites with a spinning section & a despun section on which antennas are mounted. These are kept stationary w.r.to earth by counter rotating the despunsection
15. What is meant by frequency reuse?
The carrier with opposite senses of polarization may overlap in frequency this technique is known as frequency reuse.
16. What is meant by spot beam antenna? APRIL 2023
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.
17. What is an TWTA?
The TWTAS are widely used in transponder to provide the final output power required to the transtube & its power supplies.
18. What is meant by Intermodulation distortion?
The AM/PM conversion is then a complicated function of carrier amplitudes, but in addition, the nonlinear transfer characteristic introduces a more serious form of distortion known as intermodulation distortion.
19. Define input back off.
In order to reduce the intermodulation distortion, the operating point of the TWT
must be shifted closer to the linear portion of the curve, the reduction in input power being referred to as i/p back off.
20. Define diplexer.
The transmit & receives signals are separated in a device known as diplexer.
21. Why is Uplink frequency greater than the downlink frequency?
The gain of an Antenna is α operating frequency.
3 α 1/Beam Width.
If the high band were used for downlink any given antenna would have a narrower BW thereby increasing the problems of maintaining antenna alignment as the satellite drifts around in space about its mean position to overcome this a high cost servo control Steering System would be required. By using the high band for uplink the extra gain can be usefully employed to make up for the extra path length attenuation. As the losses increase with frequency with this arrangement the overall system signal to noise ratio can be better managed. The large dish ground transmitting station will require a servo controlled Tracking system. So there is no added cost in this case
22. What are the methods used for attitude control?
The methods for attitude control are
Active attitude control: Momentum Wheels, Electromagnetic coils, mass explosion devices.
Passive attitude control: Spin Stabilization and gravity gradient stabilization.
23. What ate the functions of Telemetry, Tracking and Command Subsystem? APRIL2021



The functions of Telemetry, Tracking and Command functions are complex operations which require special ground facilities in addition to the TT&C sub system aboard the satellite.

24. What are the types of redundancy connections used in Spacecraft? NOV 2018

Different types of redundancy connections used in Spacecraft are

• Series Connections.
• Parallel Connections.
• Series/Parallel Connections.
• Switched Connection.

25. How the Capacity of a Satellite Communication System can be increased?

Capacity of Satellite Communication System can be increased by employing frequency reuse technique etc.

26. 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

27. 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.

28. 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

29. Define orthocoupler.

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

30. Give the two segments of basic satellite communication.

a. Earth segment (or) ground segment
b. Space segment

31. 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.

32. 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.

33. What is meant by payload?

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

34. 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.

35. 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.

36. 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.

37. 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.

38. 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 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.

39. What is meant by frequency reuse?

The carrier with opposite senses of polarization may overlap in frequency. This technique is known as frequency reuse.

40. 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.

41. 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.

42. 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.

43. 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.

44. What is noise weighting?

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

45. 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.

46. 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.

47. 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.

48. Define noise factor. APRIL2021

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.

49. 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.

50. Explain about Polar mount antenna

A polar mount is a movable mount for satellite dishes that allows the dish to be pointed at many geostationary satellites by slewing around one axis. It works by having its slewing axis parallel, or almost parallel, to the Earth's polar axis so that the attached dish can follow, approximately, the geostationary orbit, which lies in the plane of the Earth's equator.

PART-B

1. Discuss in detail about attitude control of a satellite. APRIL 2021

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 170-174

2. What is the chief advantage of the TWTA used aboard satellites compared to other types of high power amplifiers? What are the main disadvantages of TWTA?

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 326-329

3. What is thermal control? Why is it required? APRIL 2022

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 179

4. How do the TT and C Subsystem perform aboard the spacecraft? Also explain the working of a transponder unit ? NOV 2018 APRIL2021

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 180-186

5. How is the performance of a satellite impaired due to external factors? Also suggest suitable methods to overcome the same. APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 183

6. Explain TT&C in detail APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 180

7. Derive the downlink C/N ratio for the satellite NOV 2018

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 320

8. Explain how intermodulation noise originates in a satellite link and describe how it is reduced

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 312-319

9. Derive the link-power budget equation APRIL 2022

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 311

10. List and explain the factors governing the design of satellite links

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 302

11. 2.Explain about Polar mount antenna in detail.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 330

12. Explain about thermal control system of Satellite.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 285

13. Explain about Power supply unit of Satellites.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 290

14. Explain about Altitude Control in Detail.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 275

15. Explain about Station keeping control in satellites.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 302

UNIT-III EARTH SEGMENT

PART-A

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. What is mean by ODU and IDU. APRIL 2022
ODU – The Home Receiver Outdoor Unit
IDU – The Home Receiver Indoor Unit
3. 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.
4. Write about CATV system.
CATV – Community Antenna TV system.
As in MATV system, it consists of one out door unit and separate feeds for each sense of polarization.
5. 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.
6. What is noise weighting?
The method used to improve the post detection signal to noise ratio is referred to as noise weighting.
7. What is an EIRP?
EIRP means Equivalent Isotropic Radiated Power. It is a measure of radiated or transmitted power of an antenna.
8. What is noise power spectral density? APRIL 2022
Noise power per unit Bandwidth is termed as the noise power spectral density.
9. 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.
10. 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.
11. Define noise factor.APRIL 2021
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.
12. 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. NOV 2018 APRIL2021
EIRP = 10 log 6 + 48.2 = 56 dBW
13. 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.
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 types of Antennas used in Earth Stations?
Different types of Antennas used in Earth Stations are
1. Paraboloid Antenna with a focal point feed.
2. Cassegrain Antenna.

16. What are the requirements of an Earth Station antenna?
The requirements of Earth Station Antenna are
• High Directive Gain.
• Low Noise Temperature.
• Easily Steerable
17. What are the functions of Monitoring and Control Unit? APRIL 2023
The Monitoring and control system must have the capability to collect status data for classification. Convey status data to network operator. Interpret fault isolations. Switch over redundant equipment on command. Convey control data to the baseband equipment for traffic assignment, antenna pointing, and so forth maintain surveillance of equipment shelter facilities.
18. What is the need for demodulation and remodulation in TVRO?
A major difference between DBS TV and conventional TV is that with DBS Frequency Modulation is used where as in conventional TV amplitude modulation in the form of Vestigial Side band is used. Hence the received FM wave is demodulated and remodulated in amplitude.
19. What is DSI?
The DSI gain is the ratio of the number of terrestrial channels to number of satellite channels. It depends on the number of satellite channels provided as well the design objectives stated above.
20. What is the advantage of SPEC method over DSI method?
The SPEC method over DSI method is that freeze-out does not occur during overload conditions.
21. What is ratio of bit rate IF bandwidth? APRIL 2023
m is, $R_b/B_{IF}=m/1+\rho$ the roll of factor m=1 for BPSK
M=2 for QPSK.
22. What are the demerits of conventional approach method?
*Excessive size, weight
*Power consumption.
23. What is known as polarization interleaving with reference to the down link frequency?
The downlink frequency band of 12.2 to 12.7 GHz spans a range of 500 MHz, which accommodates 32 TV/FM channels, each of which is 24-MHz wide. Obviously some overlap occurs between channels, but these are alternately polarized left-hand circular and right hand circular or vertical/horizontal to reduce interference to acceptable levels. This is referred to as polarization interleaving. A polarizer that may be switched to the desired polarization from the indoor control unit is required at the receiving horn.
24. Define Y-factor.
Y-factor is the ratio of output noise measured when the receiver is connected to a hot noise to the output noise measured when connected to the cold source (Tc). The receiver excess noise Te is related to the Y-factor by
Tw=(Tb-YTc)/(Y-1)
25. What are the basic requirements of an earth station antenna?
The basic requirements of an earth station antenna are listed below
- The antenna must have a low noise temperature. The ohmic losses of antenna must also be maximum. The antenna must be rotated or steered easily so that a tracking system can be employed to point the antenna beam accurately
- The antenna radiation must have a low side lobe level to reduce interference from unwanted signals and also to minimize interference into other satellites and terrestrial systems. The antenna must have a high directive gain

26. Write short notes on TVRO.
The TVRO is a Receive Only Home TV systems. TVRO transmission takes place in Ku-

band. Single mesh type reflector may be used which focuses the signal into a single feed horn, which has 2 separate outputs, one for c-band signals and other for ku-band signals.

27. A transponder require a saturation flux density of -110 d Bw/m^2, operating frequency of 14 GHz. Total loss =200dB Find [EIRP].NOV 2023

Solution:

Here, [Ψs]=-110dB

F=14GHz

[L]=200dB

[A]=-(21 45+20logf)=-44.37

[EIRP] =[Ψs]+[A]+[L]
[EIRP]=-110-44.37+200

[EIRP]=45.63 dB.

28. What is a tracking?

The tracking is an important operation of the earth station. The efficiency of earth station depends as to how efficiently it points the antenna beam to the satellite both in the transmit and receive mode.

29. Write short notes on step by step technique.

The step by step technique is the most popular technique used for tracking. In this technique maximum reception of the received signal is needed and it is performed by moving and checking the beam continuously. This tracking gives a systematic pointing of the order of 0.20 3db

30. 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.

31. Why antenna tracking system necessary?

Tracking is essential when the satellite drift, as seen by an earth station antenna is a significant fraction of an earth station's antenna beam width.

An earth station's tracking system is required to perform some of the functions such as

i) Satellite acquisition
ii) Automatic tracking
iii) Manual tracking
iv) Program tracking.

32. What is DBS service?

Planned broadcasting directly to home TV receivers takes place in the Ku (12-GHz) band. This service is known as *direct broadcast satellite* (DBS) service.

33. 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.

34. What aret the methods of multiple access techniques?

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

35. 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.
36. Give the types of CDMA.
• Spread spectrum multiple access
• Pulse address multiple access
37. 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.
38. 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.
39. What is an important feature of Intelsat SCPC system? APRIL2021
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.
40. What is an TDMA? What are the advantages? NOV 2018 APRIL2021
TDMA – 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.
Advantages : The transponder traveling wave tube can be operated at maximum power output.
41. 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.
42. 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.
43. 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.
44. 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.
45. 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.
46. 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.
47. What are the types of digital speech interpolation?
• Digital time assignment speech interpolation
• Speech predictive encoded communications
48. Define Saturation flux density.
The flux density required at the receiving antenna to produce saturation of TWTA is termed the saturation flux density
49. 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.

50. 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.

PART-B

1. Explain the EIRP& Transmission losses. APRIL 2022
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370,383,

2. Describe how the gain of large antennas can be optimized.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 351

3. Explain the carrier to noise ratio of uplink & downlink frequency.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 320

4. Draw the block diagram and explain the TVRO system NOV 2018
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 209-212

5. Explain in detail the test equipment measurement on G/T, C/No.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 335

6. Explain earth station transmitter and receiver with necessary block diagram
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 214

7. Explain CATV in detail with a neat diagram APRIL 2022
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 213

8. Describe and compare the MATV and the CATV systems APRIL 2023
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 212-213

9. Explain any one test equipment for Earth stations.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 219

10. Draw the basic block of earth segment and explain.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 218

11. Show how MATV is used to provide reception of DDS to a small group of users.when this group is large what type of antenna should be used ?Explain? APRIL 2023
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 212

12. Explain about uplink and downlink frequency conversions in satellites. NOV 2018
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 221

13. Explain about link power budget in satellite.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 230

14. Explain about the basic components of Satellite in detail.
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 235

15. Write short notes about , i) Carrier to Noise Ratio. ii) Multipath propagation Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 287

UNIT-IV SATELLITE ACCESS

PART-A

1. What is an OMT?

The polarization separation takes place in a device known as an orthocoupler or orthogonal mode transducer.

2. What is an polarization interleaving?

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

3. What is an SCPC? APRIL 2022

In a thin route circuit, a transponder channel(36mhz) may be occupied by a no. of single carriers, each associated with its own voice circuit.

4. 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 ratio is sometimes referred to as the post Detector.

5. What is noise weighting?

Improve the post detection signal to noise ratio is referred to as noise weighting.

6. What is an EIRP?

It is a measure of radiated or transmitted power of an antenna. It can be completed from the antenna gain & the power fed to the antenna input.

7. Write the equations of losses for clear sky conditions. APRIL 2022Losses=(FSL)+(RFL)+(AML)+(AA)+(PL)

8. What is an noise power spectral density?

Noise power per unit BW is termed the NPS density. N0 = PN/BN=KTN joules

9. What is an Intermodulation noise?

Intermodulation distortion in high power amplifier can result in signal products which appear as noise & in fact is referred to as Intermodulation noise.

10. What are the types of antenna losses?

*sky noise

*Antenna losses

11. What is an antenna losses?

It is add to noise received as radiation & the total antenna noise temperature is in the sum of the equivalent noise temperature of all these sources.

12. Define sky noise.

It is a term used to describe the microwave radiation which is present throughout universe & which appears to originate from matter in any form ,at finite temperature.

13. Define noise factor. APRIL 2023

An alternative way of representing amplifier noise is by means of its noise factor. In defining the NF of an amplifier, denoted by two usually taken as 290k N0, out = FGKT0

14 What is an Absorptive n/w?

It is one which contains resistive elements. These introduce losses by absorbing energy from the signal& converting it to heat. Resistive attenuators, transmission lines & waveguides are all examples of absorptive networks.

15. Write the equation of system noise factor. NOV 2018

TS =Tant+ Te1+(L-1)T0/G1+L(F-1)T0/G1

16. Define saturation flux density.

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

17. A satellite downlink at 12GHZ operates with a transmit power of 6w & an antenna gain of 48.2db.Calculate the EIRP in Db.

EIRP = 10log6+48.2 =56Dbw.

18. Calculate the gain of a 3m parabolidal antenna operating at a frequency of 12GHZ.Assume an aperture efficiency of 0.5.

G=10log78168 =48.9Db

19. The range between a ground station & a satellite is 42000km. Calculate the free space loss a frequency of 6GHZ.

(FSL)=32.4+20log42000+20log6000 =200.4Db.

20. An antenna has a noise temperature of 35k & its matched into a receiver which has a noise temp of 100k. Calculate the noise power density & the noise power for a BW of 36MHZ.

N0=(35+100)X1.38X10-23 =1.86X10-21J

PN = 1.86X10-21JX36X106 =0.067PW

21. 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.

22. What is burst code word and burst position acquisition?

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

Burst position acquisition: A station just entering, or reentering after a long delay to acquire its correct slot position is known as burst position acquisition.

23. What is an single access and multiple access technique?

Single access technique: A transponder channel aboard a satellite may be fully loaded by a single transmission from earth station is called single access technique.

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.

24. What is VSAT? Write its Applications and Advantages.

VSAT stands for Very Small Aperture Terminal.

Applications:• Data Broadcasting Service.• 2 way data Service.

Advantages:

1. VSAT find advantage over terrestrial packet networks due to simpler flow and congestion control.

25. Distinguish between Demand assigned and Pre assigned Multiple Access.

Pre assigned	Demand assigned
• These are allocated on fixed or partially fixed basis to certain users • It is simple to implement but efficient only for circuits only with continuous traffic.	• All circuits are available to all users and are assigned according to the demand. • It results in more efficient over all use of the circuit but more costly and complicated to implement.

26. 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.

27. What are the limitations of FDMA-satellite access?

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 channels.

b. Carrier frequency assignments are hardware controlled.

28. What is the Concept of SS-TDMA?

The spread spectrum is one in which the transmitted signal is spread over a wide band of frequency much wider than minimum band width required to transmit the information being sent. The spreading is accomplished by means of a spreading signal called as code signal which is independent of data.

29. 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.

30. What is meant by direct closed loop feedback and feedback closed loop control?

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.

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

31. Define earth segment. APRIL 2022

Earth segment of a satellite communication system consists of transmit earth station and receive earth station. Example : TV Receive Only systems (TVRO systems)

32. Give the differences between KU-band and the C-band receive only systems.

1.Operating frequency of outdoor unit.

2.Power range

3.Attenuation level

33. What is mean by ODU and IDU. APRIL 2022

ODU – The Home Receiver Outdoor Unit IDU – The Home Receiver Indoor Unit

34. Explain about MATV system.

MATV – Master Antenna TV system. It is used to provid Example : Apartment users It consists of one outdoor unit and various indoor units. Each user can independently access all the channels.

35. 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.

36. Define S/N ratio. APRIL 2023

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.

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

38. What is an EIRP? APRIL 2023

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39. What is noise power spectral density?

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

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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.

42. 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.

43. 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

44. 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

45. An antenna has a noise temperature of 35 K and it is matched into a receiver which has a noise temperature of 100 K. Calculate the noise power density and the noise power for a BW of 36 MHz.

N 0 = (35 + 100) * 1.38 * 10-23 = 1.86 * 10 -21J P N = 1.86 * 10-21* 36 * 106= 0.067 PW .

46. What is meant by frequency reuse?

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.

47. What is DSI?

The DSI gain is the ratio of the number of terrestrial space channels to number of satellite channels. It depends on the number of satellite channels provided as well as the design objectives.

48. 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.

49. What is an single access?

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

50. What is meant by freeze out? NOV 2018

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.

51. Explain the need for a reference burst in a TDMA system APRIL 2021

The reference bursts is required at the beginning of each frame to provide timing information for acquisition and synchronization of bursts.

52. What is the use of control bits in the data frame ? APRIL 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. Since up to 8 bytes of data may be sent in one message, the control field may take values ranging from 000000 to 000111

PART-B

1. Describe the ways in which demand assignment may be carried out in FDMA

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 375

2. What is known as pre-assigned traffic?

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 395

3. Calculate the probability of false detection when N=10 and d=4

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 483

4. For digital video broadcasting what type of multiple access is best suited. Justify your answer. APRIL 2022

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 465

5. Explain FDMA in detail and also enumerate the interference in FDMA

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370-379

6. Explain direct sequence spread spectrum communication in detail.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 420

7. What is meant by back off and why it is necessary in multiple access systems.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 380-382

8. Explain digital video broadcasting in detail. NOV 2018

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 465

9. Explain what is meant by FDMA and show how this differs from FDM APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370-379

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

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 375

11. Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system. NOV 2018 APRIL 2022

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 427

12. Briefly discuss about analog voice transmission

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 488

13. Compare the silent features of FDMA, TDMA, CDMA APRIL 2023

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370,383, 417

14. Explain about CDMA in detail with necessary diagrams

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370

15. Explain about different types of spreading systems

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 370,383, 417

UNIT-V SATELLITE APPICATIONS

PART- A

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.

3. Give the types of satellite services. APRIL 2022

a. Fixed satellite service
b. Broadcasting satellite service
c. Mobile satellite service
d. Navigational satellite services
e. Meteorological satellite services

4. 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?

. INTELSAT stands for International Telecommunication Satellite. In April 6, 1965 first INTELSAT was launched. It is nicknamed as EarlyBird. Initially 11 members are made in present; there are more than 155 members and 700 earth station. INTELSAT-6 uses microprocessor with switching process. These are used for whether, DTH, telex etc.,

6. What are the applications of Radarsat?

a. Shipping and fisheries.
b. Ocean feature mapping
c. Iceberg detection
d. Crop monitoring

7. What is ECEF?

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

8. 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.

9. What is PDOP?

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

10. What is DBS? APRIL 2022

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.

11. 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

12. 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

13. 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.

14. 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)

15. Give the satellite mobile services.

a. DBS – Direct Broadcast satellite
b. VSATS – Very Small Aperture Terminals
c. MSATS – Mobile Satellite Service
d. GPS – Global Positioning Systems
e. Micro Sats
f. Orb Comm – Orbital Communications Corporation
g. Iridium

16. What is GCC and GEC?

GCC - Gateway Control Centers

GEC – Gateway Earth Stations

17. What is INMARSAT?

It is the first global mobile satellite communication system operated at L-band 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.

18. List out the regions covered by INMARSAT.

a. Atlantic ocean region, east (AOR-E)
b. Atlantic ocean region, west (AOR-W)
c. Indian ocean region (IOR)\• Pacific ocean region (POR)

19. What is INSAT? APRIL 2023

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.

20. 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.

24. Define LEO. APRIL 2023

LEO stands for Low Earth Orbit. It is defined as orbit within the locus extending from the earth surface up to an altitude of 2000 km, the commonly accepted definition for LEO is between 160-200 km above the earth surface.

25. Define MEO.

MEO stands for Medium Earth Orbit. It lies between 8000km and 18000km above the earth surface. MEO satellite ranges for orbital period for about 2 to 12 hrs Some MEO orbits are in near perfect circles and therefore have constant altitude and travel at a constant speed.

26. Define Satellite Navigational System.

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

27. What is GRAMSAT?

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

28. What are the services and features of GSM?

The GSM services are classified into 2.

- Tele services.
- Data services.

Features of GSM:

- Subscriber Indentity Module (SIM)

- On the air privacy.

29. What is the orbital spacing of satellites?

For high power satellites orbital spacing is 9^0. This orbital spacing is required to avoid adjacent interference.

30. What are VSATs? APRIL 2021

VSAT is a Very Small Aperture Terminal System. It provides two way communication facilities. Typical user groups include banking and financial institutions, airline, hotel booking agencies and large retail stores with geographically dispersed outlets.

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36. Give the satellite mobile services. NOV 2018

a. DBS – Direct Broadcast satellite

b. VSATS – Very Small Aperture Terminals

c. MSATS – Mobile Satellite Service

d. GPS – Global Positioning Systems

e. Micro Sats

f. Orb Comm – Orbital Communications Corporation

g. Iridium

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43. Define DAB.

DAB - Digital Audio Broadcast. Digital audio broadcasting (DAB), also known as digital radio and highdefinition 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.

44. What is GRAMSAT?

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

45. What is GiS?

A geographic information system (GIS), geographical information system, or geospatial information system is a system designed to capture, store, manipulate, analyze, manage and present all types of geographically referenced data. In the simplest terms, GIS is the merging of cartography, statistical analysis and database technology. GIS may be used in archaeology, geography, cartography, remote sensing, land surveying, public utility management, natural resource management, precision agriculture, photogrammetry, urban planning, emergency management, GIS in Environmental Contamination, landscape architecture, navigation, aerial video and localized search engines.

46. Write Basic concept of GPS

- the time the message was transmitted
- precise orbital information (the ephemeris)
- the general system health and rough orbits of all GPS satellites (the almanac).

47. Explain about the concepts of satellite image enhancement

Image enhancement encompasses the processes of altering images, whether they be digital photographs, traditional analog photographs, or illustrations. Traditional analog image editing is known as photo retouching, using tools such as an airbrush to modify photographs, or editing illustrations with any traditional art medium. Graphic software programs, which can be broadly grouped into vector graphics editors, raster graphics editors, and 3d modelers, are the primary tools with which a user may manipulate, enhance, and transform images. Many image editing programs are also used to render or create computer art from scratch

48. Explain about the concepts of satellite Noise reduction

Image editors may feature a number of algorithms which can add or remove noise in an image. JPEG artifacts can be removed; dust and scratches can be removed and an image can be

despeckled. Noise reduction merely estimates the state of the scene without the noise and is not a substitute for obtaining a "cleaner" image. Excessive noise reduction leads to a loss of detail, and its application is hence subject to a trade-off between the undesirability of the noise itself and that of the reduction artifacts.

49. What is mean by Dom sat?

Domestic Satellites. These are used for voice, data and video transmissions within the country. They are launched by GSLV rockets. They are placed at about 36000 km above the earth.

50. Alignment objectives for a polar mount

1.The Main axis angle must be set exactly.

2.The Dish offset tilt angle must be set exactly.

3.The central position of the main axis rotation of the mount must accurately point due south (if you are north of the equator)

51. What is the difference between active and passive satellites? APRIL 2021

Active satellite can generate power for its own operation. It is known as active repeater due to its functionality. Passive Satellite : The passive satellite is a reflector which receives the signal from the transmitting earth station and scatters the signal in all the directions.

PART-B

1. Explain i) Explain the characteristics of a typical VSAT system and Key Components for a VSAT network. (8) ii) Compare LEO and MEO satellite. What are the advantage, disadvantage and application of LEO and MEO satellite ? APRIL 2021

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 492

2. Explain direct broadcast satellite in detail APRIL 2021

Refer notes Pg No: 110

3. Explain GPS in detail with necessary diagrams.

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 495

4. Write notes on NOV 2018 APRIL 2022 APRIL 2023

i) INTELSAT

ii) E-mail

iii) BTV

iv) DTH

Refer notes Pg No: 91,116,114,111

5. Explain the operation of VSAT system in detail APRIL 2021

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 490

6. Describe the GPS functioning with a block diagram

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 495

7. Explain how DTH operation is carried out with a neat diagram APRIL 2021

Refer notes Pg No: 111

8. Write a brief note on video conferencing

Refer notes Pg No: 117

9. Explain the types of INTELSAT satellites with respect to basic space craft characteristics and vehicle type. NOV 2018 APRIL 2022

Refer notes Pg No: 91

10. Explain the block diagram of an outdoor unit for a DBS home receiver

Refer notes Pg No: 110

11. Enumerate how GSM and GPS deploying satellites have improved the mobility of the customers? APRIL 2021

Refer notes Pg No: 109

12. .Briefly explain about the features of GIS

Refer notes Pg No: 102-105

13. .Explain about different types of Map Projections in detail.

Refer notes Pg No: 102-105

14. Explain the concepts of GPS in nutshell APRIL 2023

Refer notes Pg No: 102-105

15. Briefly explain about the concepts of satellite image enhancement

Refer notes Pg No: 102-105

Geoinformatics Engineering

CEC352 – Satellite communication (Common to Electronics and Telecommunication Engineering, Electronics and Communication Engineering) (Regulations 2021)

Answer all questions

Part – A (10×2=20 Marks)

1. Given A satellite is in an orbit with a perigee of 1000 km and an apogee of 4000 km. Using a mean earth radius of 6378.14 km, find the period of the orbit in hours, minutes, and seconds

Apogee height = h a

Perigee height = h p

r a = h a + R

= 4000 + 6378.14

= 10378. 14 km

r p = h p + R

= 1000 + 6378.14

= 7378.14 km

We get a = r a + r p

a = 17,756.28

Now T = √4π^2 a^3 / G M

G = 6.672 x 10^-11 m^3/kg/s^2

M = 5974 x 1024 kg

So T = 8320.95 secs

T = 2 hrs 19 min 8 secs

2. Assume a circular orbit :Using Newton's law of gravitation and Newton's second law, determine the acceleration of a satellite.

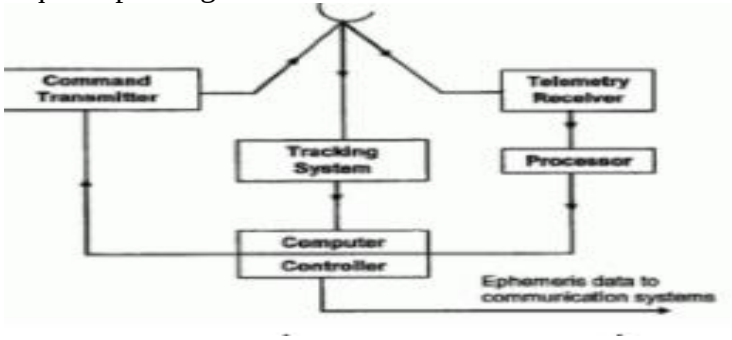
Orbital elements are the parameters required to uniquely identify a specific orbit. In celestial mechanics these elements are generally considered in classical two-body systems, where a Kepler orbit is used (derived from Newton's laws of motion and Newton's law of universal gravitation). There are many different ways to mathematically describe the same orbit, but certain schemes each consisting of a set of six parameters are commonly used in astronomy and orbital mechanics.

3. Define payload and transponder.

- The payload refers to the equipment used to provide the service for which the satellite has been launched.
- In a communication satellite, the equipment which provides the connecting link between the satellite s transmit& receive antennas is referred to as the transponder

4. Draw the block diagram of antenna subsystem

The functions of Telemetry, Tracking and Command functions are complex operations which require special ground facilities in addition to the TT&C sub system aboard the satellite.



5.Explain what is meant by 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.

6.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

7.Explain the need for a reference burst in a TDMA system

The reference bursts is required at the beginning of each frame to provide timing information for acquisition and synchronization of bursts.

8.What is the use of control bits in the data frame ?

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. Since up to 8 bytes of data may be sent in one message, the control field may take values ranging from 000000 to 000111

9. What is the difference between active and passive satellites?

Active satellite can generate power for its own operation. It is known as active repeater due to its functionality. Passive Satellite : The passive satellite is a reflector which receives the signal from the transmitting earth station and scatters the signal in all the directions.

10. What does the acronym VSAT stand for ?

VSAT is a Very Small Aperture Terminal System. It provides two way communication facilities. Typical user groups include banking and financial institutions, airline, hotel booking agencies and large retail stores with geographically dispersed outlets

Part – B

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

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

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 83

(OR)

b) i) A satellite is in a circular orbit around the earth. The altitude of the satellite's orbit above the surface of the earth is 1400 Km. i) What are the centripetal and centrifugal accelerations acting on the satellite in its orbit ? Give your answer in m/s2 . ii) What is the velocity of the satellite in this orbit ? Give your answer in km/s. iii) What is the orbital period of the satellite in this orbit ? Give your answer in hours, minutes and seconds. (10) ii) Differentiate between Geosynchronous and Geostationary orbits. (3)

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: 85

12. a) i) Define and explain the terms roll, pitch and yaw. (3) ii) Describe the tracking, telemetry and command facilities of a satellite communications system. Are these facilities part of the space segment or part of the ground segment of the system ? (10)

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 170-174

(OR)

b) i) Explain Spin Stabilization and Three-axis Stabilization. (5) ii) Explain what is meant by thermal control and why this is necessary in a satellite. (4) iii) Explain what is meant by satellite attitude and briefly describe two forms of attitude control. (4)

Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 184-194

13. a) i) A certain 6/4 GHz satellite uplink has earth station EIRP is 80 dBW; Earth station satellite distance is 35780 Km; attenuation due to atmospheric factors is 2 dB; satellite antennas aperture efficiency is 0.8; satellite antennas aperture area is 0.5 m2 ; 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)

(EIRP)dBW = 80 dBW

Figure of Merit, $M(dB) = -8$ dB

Transmission losses, $L_T(dB) = 0.6$ dB

Uplink frequency, $f = 6$ GHz

Earth station to satellite distance, $d = 35860$ km

Free space loss, $L_s(dB) = 32.45 + 20 \log_{10} d + 20 \log_{10} f$

where d in km and f in MHz.

$$L_s(dB) = 32.45 + 20 \log_{10}(35860) + 20 \log_{10}(6000)$$

$$\Rightarrow \quad L_s(dB) = 199.105 \text{ dB}$$

Carrier to noise ratio at satellite receiver input is

$$\frac{C}{N_0} = (EIRP)_{dBW} + M(dB) - L_T(dB) - L_s(dB) + 228.6$$

$$= 80 + (-8) - 0.6 - 199.105 + 228.6$$

$$\therefore \quad CNR = 100.895 \text{ dB}$$

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

Calculate the C/N in the satellite transponder for the signal transmitted by one handheld transceiver located at the edge of the coverage zone (satellite antenna gain 3 dB below maximum) and at maximum range from the satellite (2000 km).

Answer:

The EIRP of the satellite phone is 0 dBW (1 W transmitter, 0dB antenna gain)

Pr= EIRP + Gr–Lp= 0 + 3.6-3.0–162.5 =-161.9 dBW

The noise power at the input to the transponder is Nxp=-161.6 dBW

Hence (C/N)up=-0.3 dB4-24

b.Calculate the C/N in the satellite transponder for the signal transmitted by a hub station, using its full output power.

Answer:

This calculation is to establish a reference case for a single 10 kbps channel uplink.

Hub station EIRP = 20 dBW + 54 dB = 74 dBW

At the–3dB contour of the satellite antenna footprint Gr= 3.6–3.0 = +0.6 dB

Uplink power budget:

EIRP=74.0 dBW

Path loss at 29 GHz-=187.7 dB

Receive antenna gain=0.6 dB

Pr-=113.1 dBW

Noise power at satellite transponder input=-161.6 dBW

C/N at transponder input=48.5 dB

c.Calculate the C/N in the hub station receiver for the signal transmitted by a satellite transponder using its full output power.

This calculation is to establish a reference case for a single 10 kbps channel downlink.

Satellite saturated EIRP = 13 dBW + 0.6 dB = 13.6 dBW at–3 dB contour.

Downlink power budget:

EIRP=13.6 dBW

Path loss at 19 GHz=-184.0 dB

Receive antenna gain=52.0 dB

Pr=-118.4 dBW

Noise power at hub receiver input=-164.6 dBW

C/N at hub receiver=46.0 dB

d.Calculate the C/N in the receiver of the handheld unit for the signal transmitted by a satellite transponder using its full output power.=The handheld phone has an antenna gain of 0 dB.
With 20 W output from the satellite:4-25
Downlink power budget:
EIRP=13.6 dBW
Path loss at 2.5 GHz=-166.4 dB
Receive antenna gain=0 dB
Pr=-152.8 dBW
Noise power at hub receiver input=-163.8 dBW
C/N at satellite phone receiver=11.0 dB
e.Calculate the overall C/N ratios
at the hub station and at the handheld receiver.
Overall C/N values are calculated from the reciprocal formula; however, if the two C/N values differ by more than 25 dB, (C/N)o= lowest C/N ratio For the hub station, (C/N)up=-0.3 dB, (C/N)dn= 46.0 Db (C/N)o=-0.3 dB
For the handheld satellite telephone, (C/N)up= 48.5 dB, (C/N)dn= 18.0 dB(C/N)o= 18.0 dB

(OR)

b) i) Explain what is meant by saturation flux density. The power received by a 1.8 m parabolic antenna at 14 GHz is 250 pW. Calculate the power flux density (a) in W/m2 and (b) in dBW/m2 at the antenna. (5) ii) Explain what is meant by input backoff. An earth station is required to operate at an [EIRP] of 44 dBW in order to produce saturation of the satellite transponder. If the transponder has to be operated in a 10 dB backoff mode, calculate the new value of [EIRP] required. (5) iii) Two amplifiers are connected in cascade, each having a gain of 10 dB and a noise temperature of 200 K. Calculate (a) the overall gain and (b) the effective noise temperature referred to input. (3)
a. Calculate the path loss at 6.1 GHz. Wavelength is 0.04918 m.
Answer:
Path loss $= 20 \log (4 \pi R / \lambda) = 20 \log (4 \pi \times 37{,}500 \times 103 / 0.04918)$ dB
$Lp = 199.6$ dB
b. Calculate the power at the output port (sometimes called the output waveguide flange) of the satellite antenna, in dBW.
Answer:
Uplink power budget gives
$Pr = Pt + Gt + Gr - Lp$ dBW $= 20 + 54 + 26 - 199.6 = -99.6$ dBW
c. Calculate the noise power at the transponder input, in dBW, in a bandwidth of 36 MHz.
Answer
: $N = k\,Ts\,BN = -228.6 + 27 + 75.6 = -126.0$ dBW
d. Calculate the C/N ratio, in dB, in the transponder.
Answer:
$C/N = Pr - N = -99.6 + 126.0 = 26.4$ dB
e. Calculate the carrier power, in dBW and in watts, at the transponder output.
Answer:
The gain of the transponder is 110 dB. Output power is
$Pt = Pr + G = -99.6 + 110 = 10.4$ dBW or $101.04 = 11.0$ W
14. . a) i) Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network. (7) ii) Given that the IF bandwidth for a 252-channel FM/FDM telephony carrier is 7.52 MHz and that the required [C/N] ratio at the earth station receiver is 13 dB, calculate (a) the [C/T] ratio and (b) the satellite [EIRP] required if the total losses amount to 200 dB and the earth station [G/T] ratio is 37.5 dB/K. (6)
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 170-174

(OR)

b) i) Briefly describe the ways in which demand assignment may be carried out in an FDMA network. (5) ii) What is the function of : a) the burst-code word and b) the carrier and bit-timing recovery channel in a TDMA burst ? (4) iii) In a TDMA network the reference burst and the preamble each requires 560 bits, and the nominal guard interval between bursts is equivalent to 120 bits. Given that there are eight traffic bursts and one reference burst per frame and the total frame length is equivalent to 40, 800 bits, calculate the frame efficiency. (4)
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 215-216

15. a) i) Explain the characteristics of a typical VSAT system and Key Components for a VSAT network. (8) ii) Compare LEO and MEO satellite. What are the advantage, disadvantage and application of LEO and MEO satellite ? (5)
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 217-220

(OR)

b) i) Explain the working of Global Positioning System. (8) ii) Explain the working of Direct Broadcast Satellites in detail. (5)
Dennis Roddy, 'Satellite Communication', McGraw Hill International, 2006. Pg: Pg: 215-216

Part – C (1×15=15 Marks)

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

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

(a) Determine if the code is a Hamming code. Find the parity check matrix $-\rightarrow H$ of the code in systematic form. (b) Find the encoding table for the linear block code. (c) What is the minimum distance dmin of the code. How many errors can the code detect. How many errors can the code correct. (d) Draw the hardware encoder diagram. (e) Find the decoding table for the linear block code. (f) Draw the hardware syndrome generator diagram. (g) Suppose $-\rightarrow c$ = 1 1 1 0 0 0 is sent and $-\rightarrow r$ = 1 1 1 0 0 1 is received. Show how the code can correct this error.

Testing for hamming code, we have

$$\begin{aligned} m &= n-k=6-3=3 \\ k &= 2^m-m-1=2^3-3-1=4\neq 3 \\ n &= 2^m-1=2^3-1=7\neq 6 \end{aligned}$$

Hence $(6,3)$ is not a Hamming code.

We have

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

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

$$\vec{P}^T = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$$

$$\vec{I}_3 = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$$

$$\vec{H} = [\vec{P}^T : \vec{I}_{n-k}]$$

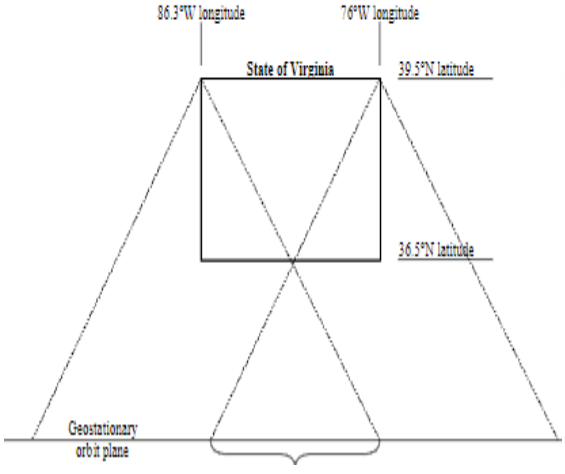
$$\vec{H} = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(OR)

b) i) The state of Virginia may be represented roughly as a rectangle bounded by 39.5° N latitude on the north, 36.5° N latitude on the south, 76.0° W longitude on the east and 86.3° W longitude on the west. If a geostationary satellite must be visible throughout virginia at an elevation angle no lower than 20°, what is the range of longitudes within which the sub-satellite point of the satellite must lie ? (10) ii) A ground station lies at latitude = 39.2906 degrees N and longitude = 280.2629 degrees E. A Geostationary satellite at radius r = 42164 km has a longitude of 280.2629 degrees E. Calculate the range and look angles (azimuth and elevation angles) to the satellite. (5)

This question is similar in concept to the previous question, and the same quadratic solution may be applied. The schematic below illustrates the geometry of the question.

Range of sub-satellite points giving a minimum of 20° elevation angles in Virginia



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Using the same quadratic equation in the solution to question 9 gives γ = 61.8279251°.

The lowest elevation angles will be at earth stations located at the north most corners of Virginia. That is at latitude 39.5°N, with one at 76°W and the other at 86.3°W. The factor cos(La) will be the same in both cases, cos(39.5) = 0.7716246, as will cos(ls – le), which will be cos(61.8279251)/(0.7716246) = 0.6118535, which yields a separation between ls and le of 52.2763585°.

Thus the satellite may be approximately 52.3° east or west of the earth station to remain at an elevation angle of 20°. However, to enable the other northern corner of Virginia to still "see" the satellite at an elevation angle of at least 20°, the satellite must be east of the west most earth station and west of the east most earth station. The east most northern earth station site is at 76°W and the west most earth station site is at 86.3°W. The sub-satellite points must therefore be between 76°W + 52.2763585 = 128.2763585°W and 86.3°W – 52.2763585 = 34.0236415°W