Satellite Communication and GPS-18EC5DEBSG

MODULE 1

1. Explain briefly about various Satellite communication services. 6 Marks
2. State and explain the Kepler's law of planetary motion with neat diagram and necessary equations. 10 Marks
3. Explain the frequency bands used for satellite services. 5 Marks
4. What are the advantages and disadvantages of Satellite communication? 4+3 Marks
5. What are the orbital perturbations that take place because of non spherical nature of earth and gravitational forces of the sun and moon? 10 Marks
6. With the help of neat diagram, explain Keplerian elemental set (orbital elements). 8 Marks
7. Define the terms: (i) Ascending node (ii) Descending node (iii) Line of apsides (iv) Prograde orbit (v) Retrograde orbit (vi) Mean anomaly (vii) True anomaly. 7 Marks
8. Develop the Equations for orbit velocity and orbit duration of a satellite. 5 Marks
9. Find the eccentricity of an elliptical orbit for which apogee height is 30000 km and perigee height is 5000 km. 4 Marks
10. What are Elevation and Azimuth angles? Explain how to calculate these two angles for an earth station antenna towards a geostationary satellite. 10 Marks
11. A communication satellite is positioned at 74 degree east longitude. A ground station is situated with co-ordinates of 78 degree east longitude and 13.5 north latitude. Calculate the elevation and azimuth angles of ground antenna to point to the satellite. 6 Marks
12. A satellite is in an elliptical 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, and the eccentricity of the orbit. 6 Marks
13. Calculate the Doppler shift for a LEO satellite transmitter working at 205 GHz and at an orbital height of 1000 km circular orbit. 6 Marks
14. Explain in detail the Doppler frequency shift for a low earth orbiting satellite transmission. 6 Marks

MODULE 2

1. What are the major subsystems of a communication satellite? Explain its functions. 4 Marks
2. What is a satellite transponder? With a neat block diagram explain the overall frequency arrangement of typical C- band communication satellite. 10 Marks
3. What is meant by satellite attitude? Briefly describe spin stabilization of the satellite. 6Marks
4. What is attitude control as applicable to satellites? Briefly describe three axis stabilization of the satellite. 10 Marks
5. With neat block diagram explain briefly the satellite power system. 6 Marks

6. Describe briefly the Telemetry, Tracking and Command system of a communication satellite, with the necessary block diagrams.

7. Write short note on i) Satellite Structures ii)Thermal Control system 10 Marks
8. Explain concept of reliability with the help of bath tub curve, with reference to components used in satellite systems. 6 Marks
9. Explain the terms i) MTBF ii)Reliability iii)redundancy 6 Marks
10. List and briefly explain the steps in satellite mission realization. 6Marks
11. Write short notes on: (i) Atmospheric losses and (ii) Ionospheric effects. 6 Marks
12. Explain what are rain rate specific attenuation and effective path length in connection to rain attenuation? 6 Marks
13. Calculate the rain attenuation for horizontal, vertical and circular polarizations, for a frequency of 12 GHz. The rain attenuation is exceeded for 0.01% of the time in any year, for a point rain rate of 20 mm/hr. The earth station attitude is 700 m and the antenna elevation angle is 50^o. The rain height is 3km and a_h=0.0188, b_h=1.217, a_v=0.0168 and b_v=1.2. 10 Marks
14. Explain in detail the satellite antennas with necessary diagrams and equations. 10 Marks

MODULE 3

1. Explain what is meant by EIRP? A satellite downlink at 24 GHz operates with a transmit power of 12W, calculate the gain of a 3m paraboloidal antenna and the EIRP in dbW. Assume an aperture efficiency of 0.55. 8 Marks
2. Explain the free space transmission loss and derive the expression for received power in dB. 6 Marks
3. List and explain four different transmission losses in satellite communication. 6 Marks
4. Derive the expression for overall system noise temperature of a two stage cascaded amplifier. 6 Marks
5. What is noise factor? Show the equivalence between noise factor and noise temperature. A LNA is connected to a receiver which has a noise figure of 14 dB. The gain of the LNA is 45 dB, and its noise temperature is 130 K. Calculate the overall noise temperature referred to the LNA input. 8 Marks
6. Derive expression for the noise temperature for an absorptive network. Show that at room temperature the noise factor of a lossy network is equal to the power loss. 6 Marks
7. With relevant expressions explain what is carrier to noise ratio. 6 Marks
8. Define Saturation flux density. Obtain the equation for saturation EIRP for uplink. 8 Marks
9. What is input backoff? An uplink at 15 GHz requires a saturation flux density of -92.5 dBW/m^2 and an input backoff of 12 dB. The satellite G/T is -7.6 dBK^{-1}, and receiver feeder loss amount to 0.8 dB. Calculate the carrier to noise density ratio. 6 Marks
10. What is output backoff? The specified parameters for downlink are satellite saturation value of EIRP is 25 dBW, output backoff is 7 dB, free space loss is 198 dB, allowance for other

downlink losses is 1.7 dB and earth station G/T is 41 dBK^{-1}. Calculate the carrier to noise density ratio at the earth station. 6 Marks

11. A satellite is operated at an EIRP of 58 dBW with an output backoff of 7 dB. The transmitter feeder losses amount to 2 dB and the antenna gain is 50 dB. Calculate the power output of the TWTA required for full saturated EIRP. 4 Marks
12. A multiple carrier satellite circuit operates in the 6/4 G Hz band with the following characteristics. Uplink: Saturation flux density = -67.5 dBW/m^2, input backoff=11 dB, Satellite G/T= -11.6 dBK^{-1}. Downlink: Satellite Saturation EIRP=26.6 dBW, output backoff=6dB, FSL=196.7 dB, Earth station G/T= 40.7 6 dBK^{-1}, K=1.38x10^{-23} J/K. The other losses may be ignored. Calculate the CNR for both uplink and downlink and the combined value. 8 Marks
13. For the system shown in below fig. 1 and 2, the receiver noise figure is 12 dB, the cable loss is 5dB, the LNA gain is 50dB and its noise temperature is 150K. The antenna noise temperature is 35K. Calculate the noise temperature referred to the input. 8 Marks

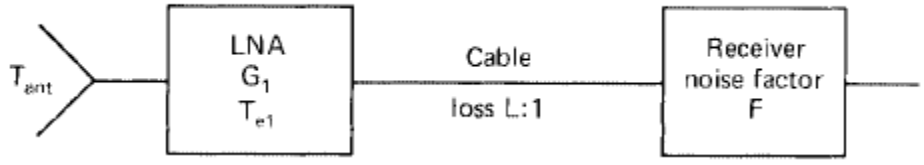

Fig.1

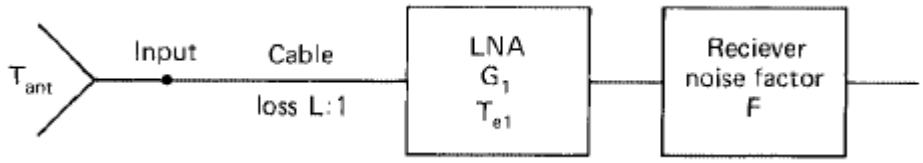

Fig.2

14. With necessary diagrams derive the expression for combined uplink and downlink C/N ratio clearly showing steps for uplink and downlink C/N ratio. 8 Marks

15. Describe briefly the modes of interference that can occur in satellite communication system. Distinguish between the satellite and terrestrial modes of interference. 10 Marks
16. In a satellite system, (i) The desired carrier [EIRP] from a satellite is 34 dBW, and the ground station receiving antenna gain is 44 dB in the desired direction and 24.47 dB toward the interfering satellite. The interfering satellite also radiates an [EIRP] of 34 dBW. The polarization discrimination is 4 dB. Calculate the [C/I] ratio at the ground receiving antenna.
    (ii) Station A transmits at 24 dBW with an antenna gain of 54 dB and station C transmits at 30 dBW. The off axis gain in the S1 direction is 24.47 dB and the polarization discrimination is 4 dB. Calculate the [C/I] ratio on the uplink.
    (iii) Find the overall ratio [C/I] using the uplink and downlink values of [C/I] calculated. 7 Marks

17. Explain B1 and B2 modes of interferences with relevant diagrams and Derive C/I ratio for uplink. 8 Marks
18. Explain B1 and B2 modes of interferences with relevant diagrams and Derive C/I ratio for downlink. 8 Marks
19. With necessary diagrams derive the expression for combined uplink and downlink C/N ratio clearly showing steps for uplink and downlink C/N ratio. 10 Marks

Module-4

1. What is meant by Navigation and Radio Navigation? What is the need for Navigation?
2. Briefly explain the history of GPS.
3. Give overview of GPS system w.r.t. no of satellites, Orbital information, Frequencies, codes, modulation and services.
4. Explain in detail PPS and SPS provided by GPS.
5. What is meant by Denial of accuracy and access? Explain SA and AS in GPS system.
6. With neat diagrams explain Concept of Ranging Using TOA Measurements.
   OR
7. Illustrate Two-Dimensional Position Determination
8. Illustrate and explain the effect of Clock Offset and Measurement Errors on Position Certainty
9. Explain Three-Dimensional Position Location used in GPS.
10. Explain ECEF system. What is importance of ECEF system?
11. Explain in detail the Position Determination Using PRN Codes
12. Give mathematical approach for Calculation of User Position in GPS
13. Illustrate GPS satellite constellation giving details of orbits
14. Illustrate a generic SPS receiver block diagram and elaborate operation of each block.
15. List the principal components of a GPS receiver and explain the GPS antenna in detail.
16. List all the parameters for choosing a GPS receiver
17. Illustrate and explain the GPS Navigation Message Format
18. What is the significance of TLM and HOW? Show the structure a subframe indicating TLM and HOW
19. Explain the information provided by Subframe 1
20. Briefly explain the different subframes of GPS.
21. List and briefly explain modernized GPS signals/Give an overview of modernized GPS signals
22. Explain L2 Civil Signal of GPS.
23. Explain M-Signal of GPS
24. Explain L5 Signal of GPS.

Module-5

1. What is the need for acquisition and tracking in GPS receiver?
2. Write the Generic digital GPS receiver block diagram and briefly explain each block.

3. With the help of Generic digital receiver channel block diagram explain GPS Receiver Code and Carrier Tracking.
4. Demonstrate Signal Acquisition in GPS using time domain search techniques.
5. Give the sequence of Initial Receiver Operations in a GPS receiver.
6. Discuss the use of Digital Processing in GPS/How Digital Processing has helped the navigation using GPS
7. Discuss the considerations for Indoor Applications.

   OR

   How does the GPS receiver works in environments where the C/N0 is lower than the normal situation

   OR

   Explain/Discuss the considerations for GPS receiver while working in environments where the C/N0 is lower than the normal situation
8. Discuss Marine Navigation applications of GPS.
9. Explain how GPS assists in air Navigation.
10. List and briefly explain Land Navigation applications of GPS
11. What is ITS? Explain how GPS can be used in ITS.
12. Explain Application of GPS in Surveying and Mapping.
13. What is GIS? Explain
14. How GPS can be used in GIS? List and briefly explain the applications.
15. Discuss the role of GPS in Military applications.
16. List the government applications of GPS.