

Code No: **R1642043**

R16

Set No. 1

IV B.Tech II Semester Regular Examinations, September - 2020

SATELLITE COMMUNICATIONS
(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

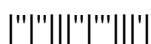
Answer any FOUR questions from Part-B

PART-A(14 Marks)

1. a) What is sub satellite point of a satellite system? [2]
- b) List out the various orbital elements. [2]
- c) Why uplink and down link frequencies are different for a satellite system? [3]
- d) Write the differences between multiplexing and multiple access. [2]
- e) What are the earth station design considerations? [3]
- f) What are the functions of GPS monitoring stations? [2]

PART-B(4x14 = 56 Marks)

2. a) What are the various orbital effects in satellite communication system performance? Explain. [7]
- b) 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. [7]
3. a) What are the various satellite subsystems? Explain TTC & M subsystem with a neat block diagram. [7]
- b) Explain the 14/11 GHz transponder with a neat block diagram. [7]
4. a) Derive the expression for C/N ratio of a satellite link. [7]
- b) Suppose, we have a 4-GHz satellite receiver with the following gains and noise temperatures: $T_{in} = 25$ K, $T_{RF} = 50$ K, $T_{IF} = 1000$ K, $T_m = 500$ K, $G_{RF} = 23$ dB and $G_{IF} = 30$ dB. Calculate the system noise temperature, if the mixer has a
 - i) gain of 0 dB and
 - ii) 10 dB loss. [7]
5. a) What is intermodulation in FDMA? Explain in detail with relevant expressions. [7]
- b) Explain the principle and advantages of CDMA technique. [7]
6. a) What are the different types of antenna mounts used at satellite earth station? Explain. [7]
- b) Compare the low earth orbit and geostationary satellite systems with respect to orbit, coverage and operating frequency. [7]
7. a) Explain the basic GPS receiver with the help of a block diagram. [7]
- b) Explain the principle and advantages of Differential GPS. [7]



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PART-A(14 Marks)

1. a) What are the differences between the geosynchronous and geostationary orbits? [2]
- b) What is a transponder? Write the various types of transponders used with a satellite. [3]
- c) Define the G/T ratio of a satellite link. [2]
- d) Write the advantages of CDMA technique. [2]
- e) List out the different types of antennas used at satellite earth station. [2]
- f) Write the different sources of GPS errors. [3]

PART-B(4x14 = 56 Marks)

2. a) What is elevation angle with respect to a satellite? Derive the expression for it. [8]
- b) The coordinates of the INSAT GEO satellite are 83°E and 0°N . The earth station is located at Hyderabad 78°E and 17°N . Find the earth station elevation angle to INSAT. [6]
3. a) What are the various satellite subsystems? Explain attitude and orbit control system in detail. [7]
- b) Explain the 6/4 GHz single conversion transponder with a neat block diagram. [7]
4. a) Derive the expression for system noise temperature in a satellite system. [7]
- b) A satellite in GEO orbit is at a distance of 39000 km from an earth station. The required flux density at the satellite to saturate one transponder at a frequency of 14.3 GHz is -90 dBW/m^2 . The earth station has a transmitting antenna with a gain of 52 dB. Find the output power of the earth station transmitter. [7]
5. a) Explain the TDMA frame structure with the help of a neat diagram. [7]
- b) Compare FDMA and TDMA. [7]
6. a) Explain the operation of earth station receiver with the help of a neat block diagram. [7]
- b) What are various NGSO constellation designs? Explain in detail. [7]
7. a) Explain the generation of GPS L1 and L2 signals. [7]
- b) Explain the principle of Differential GPS. [7]

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PART-A(14 Marks)

1. a) Write the applications of satellite communications. [2]
- b) What are the causes for attitude and orbital changes for a satellite system? [3]
- c) Write the expression for overall C/N ratio of a satellite system. [2]
- d) Define the efficiency of TDMA and write the expression for it. [3]
- e) List out the disadvantages of LEO satellites. [2]
- f) What are the functions of GPS master control station? [2]

PART-B(4x14 = 56 Marks)

2. a) Explain the brief history of satellite communication systems. [7]
- b) What are the look angles with respect to a satellite? Explain with relevant diagrams. [7]
3. a) What are the various satellite subsystems? Explain communication subsystem with a neat block diagram. [8]
- b) Explain the various types of antennas used for satellite communication. [6]
4. a) Derive the expression for satellite link equation. [7]
- b) A satellite at a distance of 40000 km from a point on the earth's surface radiates a power of 10 W from an antenna with a gain of 17 dB in the direction of the observer. Find the power received by an antenna with an effective area of 10 m². [7]
5. a) Explain the principle, advantages and disadvantages of FDMA with necessary diagrams. [9]
- b) Find the number of channels for a satellite system with FDMA that has a bandwidth of 12.5 MHz with a channel bandwidth of 30 KHz and guard band of 10 KHz. [5]
6. a) Explain the operation of earth station tracking subsystem with the help of a neat diagram. [7]
- b) What are the different satellite constellation designs? Explain any one. [7]
7. a) Draw the basic architecture of GPS and explain in detail. [7]
- b) Compare the performance of GPS and Differential GPS. [7]



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PART-A(14 Marks)

1. a) What is apogee and perigee of a satellite system? [3]
- b) Define telemetry and tracking. [2]
- c) Write the various losses to be considered for a satellite link. [3]
- d) Write the disadvantages of FDMA. [2]
- e) What are the various types of power amplifiers used at satellite earth station? [2]
- f) What are the limitations of GPS? [2]

PART-B(4x14 = 56 Marks)

2. a) Explain the Kepler's laws of planetary motion. [7]
- b) What is azimuth angle with respect to a satellite? Derive the expression for it. [7]
3. a) What are the various satellite subsystems? Explain the power system. [7]
- b) Explain the redundancy type of approach used for improving equipment reliability in satellite. [7]
4. a) Derive the expression for G/T ratio of a satellite link. [7]
- b) The thermal noise in an earth station receiver results in a $(C/N)_{dn}$ ratio of 20 dB. A signal is received from a transponder with a carrier to noise ratio $(C/N)_{up}$ of 20 dB.
 - i) What is the value of overall (C/N) ratio at the earth station?
 - ii) If the transponder introduces intermodulation products with (C/I) ratio of 24 dB, what is the overall (C/N) ratio? [7]
5. a) Explain the principle, advantages and disadvantages of TDMA with necessary diagrams. [7]
- b) Find the frame efficiency of a satellite system with TDMA that has a time slot consists of 6 trailing bits, 8.25 guard bits, 26 training bits, and 2 traffic bursts of 58 bits of data. [7]
6. a) Draw the general configuration of an earth station and explain each block. [7]
- b) Explain the delay considerations of LEO, MEO and GEO satellites. [7]
7. a) Explain the various functions of Ground segment of GPS architecture. [7]
- b) Describe the format of GPS navigation message. [7]

