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Total Number of Pages: 2

M.TECH  
ETPE102

1st Semester Regular/Back Examination – 2014

**SATELLITE COMMUNICATION SYSTEM**

BRANCH(S): ELECTRONICS & TELE COMMUNICATION ENGINEERING, ELECTRONICS  
& COMMUNICATIONS ENGINEERING, COMMUNICATION SYSTEMS

Time: 3 Hours

Max marks: 70

Answer Question No.1 which is compulsory and any five from the rest.  
The figures in the right hand margin indicate marks.

- Q1 Answer the following questions: (2x10)
- Which type of modulation scheme is suitable for satellite system? Justify
  - What do you mean by jamming?
  - Mention various kinds of interference in satellite communication. How terrestrial interference occurs?
  - Explain Tropospheric Scintillation.
  - Explain the function of guard time in a satellite TDMA system.
  - What do you mean by SPADE system? Briefly explain
  - Write a relation between noise figure and noise temperature.
  - What do you mean by Subsatellite Point?
  - What is multiple access? What is the basic principle of operation of CDMA?
  - Calculate the maximum time a satellite in circular orbit is visible to a user on the surface of the earth?
- 2 a) A C Band earth station has an antenna with a transmit gain of 54 db. The transmitter output is set to 100 w at a frequency of 6.10 GHz. The signal is received by a satellite at a distance of 37, 500 km by an antenna with a gain of 26 db. The signal is then routed to a transponder with a noise temperature of 500k, a band width of 36 MHz, and a gain of 110 dB. (10)
- Calculate the path loss at 6.1 GHz
  - Calculate the power at the output port of the satellite antenna in dBW.
  - Calculate the noise power at the transponder input in dBW.
  - Calculate the C/N ratio in dB, in the transponder.
  - Calculate the carrier power in dBW at the transponder output.
- Q3 a) Discuss the significant properties of a PN sequence used in spread spectrum satellite system. (5)
- b) Briefly explain the principle of DSSS and FHSS. (5)
- Q4 a) Five earth stations share one transponder of a 6/4 GHz satellite. The satellite and earth station characteristics are given below: (7)
- Satellite  
Transponder BW = 36 MHz  
Transponder gain = 90 dB (max)  
Input noise temp. = 550 K  
Saturated output power = 20 W (max)  
4 GHz antenna gain = 20.0 dB  
6 GHz antenna gain = 22.0 dB

Earth station

4 GHz antenna gain = 60.0 dB

6 GHz antenna gain = 63.0 dB

Receive System Temp. = 100 K

Path loss

At 4 GHz,  $L_p = 196$  dB

At 6 GHz,  $L_p = 200$  dB

The stations all operate in a TDMA mode. Speech signals are sampled at 8 kHz, using 8 bits/sample. The sampled signals (PCM) are then multiplexed into 40 Mbps streams at each station, using QPSK.

- i. Find the bit rate for each PCM signal.
  - ii. The number of speech signals (as PCM) that could be sent by each earth station, as a single access, with no overhead (i.e. no header or CRC, etc.). This is a TDM data stream.
  - iii. The shortest frame time for any TDMA scheme.
- b) Determine the apogee, perigee and orbit eccentricity in a satellite's elliptical eccentric orbit, if the farthest and closest points from earth's surface are 24000 km and 600 km respectively. The radius of earth is 6370 km. (3)
- Q5 a) An Earth station antenna (of diameter of 30 m) has an overall efficiency ( $\eta$  %) of 60% and is used to receive a signal at 4150 MHz. At this frequency, the system noise temperature is 79K, when the antenna points at the satellite at an elevation angle of  $28^\circ$ . What is the earth station G/T under these conditions? (5)
- b) Derive an expression for system noise temperature and G/T ratio. (5)
- Q6 a) With proper block diagram describe a typical tracking, telemetry, command and monitoring system (5)
- b) What is the role of Satellite transponders? With proper block diagram explain the working of a double conversion transponder. (5)
- Q7 Consider a TDMA frame with the following parameters. (10)
- TDMA frame length: 16 ms
  - TDMA burst bit rate: 60 Mbps
  - 92 traffic bursts and 2 reference bursts
  - CCR sequence: 256 bits
  - UW sequence: 20 bits
  - Order wire channel: 512 bits
  - Management channel: 226 bits
  - Transmit timing channel: 320 bits
  - Service channel: 256 bits
  - Guard time: 32 bits
- i. Find the frame efficiency.
  - ii. How many T1 carriers can the frame accommodate?
  - iii. How many 32-kbps voice channels can the frame accommodate?
- Q8 Describe any TWO from the following (5+5)
- a) Spread Spectrum Transmission and Reception
  - b) Orbital effects in Communication system performance
  - c) Satellite mobile service.
  - d) VSAT System.



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