AMIETE – ET (OLD SCHEME)

Code: AE22   **Subject: SATELLITE & SPACE COMMUNICATION**
Time: 3 Hours   **DECEMBER**   **Max. Marks: 100**

NOTE: There are 9 Questions in all.
- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2x10)**

a. The first artificial earth satellite that sparked the space race between the US and the USSR was

(A) SPUTNIK I   **(B)** EXPLORER I
(C) The SCORE   **(D)** TELSTAR

b. If an earth station is located in the Northern Hemisphere with satellite to the SW of the earth station, then the azimuth look angle Az can be found from

(A) $Az = 180° - \alpha$ **(B)** $Az = 90° + \alpha$

(C) $Az = -\alpha$ **(D)** $Az = 180° + \alpha$

c. The calculations towards the evaluation of the central angle for an earth station with respect to a geostationary satellite leads to a value of $75.4981°$. Then the resulting elevation angle would be

(A) $6.347°$ **(B)** $3.847°$

(C) $5.847°$ **(D)** $9.32°$

d. If the effective path length of the signal through the rain is 'L' and the specific attenuation is 'α' then the total attenuation can be determined as,

(A) $\alpha^2 L$ dB   **(B)** $\alpha\sqrt{L}$ dB

(C) $\sqrt{\alpha L}$ dB   **(D)** αL dB

e. If the free-space loss at a frequency of 6 GHz between a ground station and a satellite is 200.4 dB, then the range of the link is

(A) 40000 Km   **(B)** 38500 Km
(C) 42000 Km   **(D)** 39000 Km

f. The signalling bit rate for the Bell T1 TDM system is

(A) 1.922 Kb/S   **(B)** 1.731 Kb/S

(C) 1.333 Kb/S   **(D)** 1.833 Kb/S

g. The operating frequency of a 3-m paroboloidal antenna with an aperture efficiency of 0.55 and a gain of 48.9 dB is

   (A) 8 GHz   (B) 9.5 GHz
   (C) 12 GHz   (D) 6 GHz

h. A VSAT network consists of 250 Ku-band VSAT earth stations sharing one inbound and one outbound transponder on a GEO satellite. If the transponder bandwidth is 54 MHz and if the requirement on carrier-to-carrier spacing is 115 KHz, then the maximum number of channels that can be carried by the inbound transponder is

   (A) 359   (B) 179
   (C) 247   (D) 469

i. A (15, 7) BCH code can correct upto

   (A) one error   (B) two errors
   (C) three errors   (D) seven errors

j. In the united states rapid growth of VSAT networks took place in

   (A) 1960s   (B) 1980s
   (C) 1970s   (D) 1990s

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Why 99% of all satellites during mid-1963 were launched into LEO? What is it that lead to the establishment of NEWSKIES?   **(7)**

b. Define the term 'Elevation' as applied to a satellite. Write the equation that permit the calculation of the elevation angle, with usual notations and comment on the quantities that appear   in   the   above   equation.
(5)

c. If the earth rotates once per sidereal day of 23 hours, 56 min, 4.09 seconds, calculate the radius   of   the GEO.
(4)

Q.3 a. What are ionospheric scintillations? How are they caused? Comment on its effect on the radio wave.   **(8)**

b. Explain the requirement of the RF amplifier in a satellite communication receiver? Based on its requirement, what is its other name? What do you mean by a "low noise block converter" and what is its location for a receiver? Write the block diagram of a double conversion earth station receiver.   **(8)**

Q.4   a.   Describe the art of good system design and also, write a brief note on link budget.
(8)

   b.   The details of a C-Band GEO satellite are given below:
   (i)   Transponder saturated output power = 20W
   (ii)   Output back-off = 2 dB
   (iii)   Antenna gain, on axis = 20 dB
   (iv)   Receiving earth stations antenna gain @4 GHz = 49.7 dB.
   (v)   Receiving system noise temperature = 75 K.
   Calculate
   (i)   diameter of the antenna at 4 GHz
   (ii)   saturated output power of the transponder in dBW.
   (iii)   power transmitted by the transponder in dBW.
   (iv)   on-axis EIRP of the transponder and antenna in dBW.
   (v)   G/T ratio for the earth station.
   (vi)   path loss at 4 GHz over the maximum path length for a GEO
   satellite link.   **(8)**

Q.5   a.   Write a brief note on pre-emphasis and de-emphasis.   **(6)**

   b.   Why TDM is considered as the natural way for combining digital signals for
   transmission? Define the following binary modulation methods which can be used for
   transmission to and from a satellite of a baseband digital signal,
   (i)   BPSK   (ii)   DPSK
   (iii)   QPSK   (iv)   QAM   **(10)**

Q.6   a.   What do you mean by 'attitude' of a satellite? Distinguish between passive and active
   attitude control.   **(7)**

   b.   With a block schematic for illustration, briefly describe a satellite wideband
   receiver.   **(9)**

Q.7   a.   What do you mean by multiple access? Distinguish between TDM and TDMA. With a
   sketch for illustration briefly explain the TDMA frame structure with four transmitting
   earth stations.   **(12)**

   b.   For an INTELSAT frame, the overhead symbols are 6144 and the total frame length is
   120,832 symbols. Compute the frame efficiency.   **(4)**

Q.8   a.   What is CDMA? How are CDMA signals encoded? What do you mean by 'chips' used
   in a CDMA code and what is its function?   **(6)**

   b.   What does a VSAT network do? Comment on the traffic stream handled by VSAT
   networks. Write the schematic of the typical TDM downlink "outbound" channel from
   the hub, via the satellite, to the individual VSAT terminals and highlight its
   feature.   **(10)**

Q.9 a. Write Shannon's mathematical formula for the capacity of a noisy channel. Define the term spectral efficiency of the digital communication link. When do you say that a link is power limited? **(5)**

  b. Explain the difference between BCH codes and Reed-Solomon codes based on their utility? Define the term code rate of Reed-Solomon code.   **(5)**

  c. Describe the type of encoder as shown below:
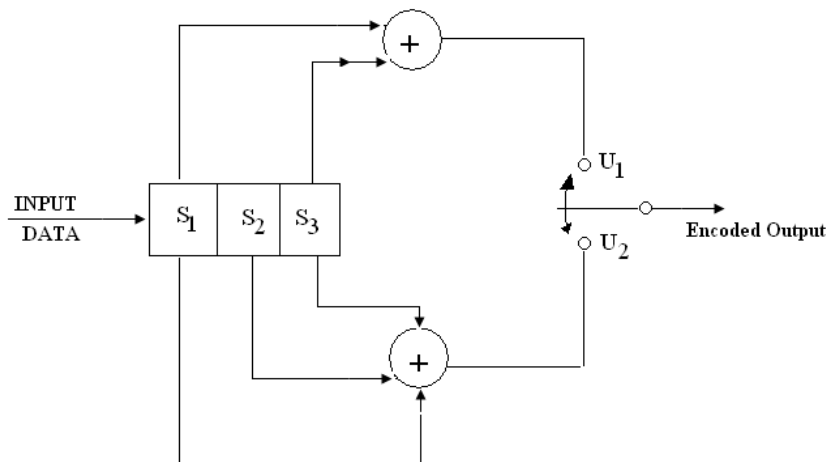
Also, explain the encoding operation. **(6)**