

- N.B.** (1) Question No. 1 is compulsory.  
 (2) Solve any **four** questions from Question Nos. 2 to 7.  
 (3) Draw **neat** sketches/diagrams, wherever **necessary**.  
 (4) Make **suitable** assumptions, wherever **necessary** and **justify** it.  
 (5) **Figures** to the **right** indicate **full** marks.
- Define the following terms : 5
      - True anomaly (iv) Doppler Shift
      - Jamming Margin (v) Equinox.
      - Antenna Bandwidth
    - A PN sequence is generated using a feedback register of length  $M = 4$ . The chip rate is 107 chips per second. Find the following parameters :— 2
      - PN sequence length 2
      - Chip duration of PN sequence 1
      - PN sequence period.
    - Mention atleast ten points of comparison between Low altitude, Medium altitude and High altitude satellites. 10
  - Derive the expression for satellite look angle coverage angle, and slant range. 12
    - Explain with frame structure the Demand Assignment TDMA scheme. 8
  - What is telemetry, tracking and command subsystem ? Explain its functioning with block diagram. What kind of antennas are used for tracking and command signal transmission during transfer orbit and on orbit ? 10
    - Draw a block diagram for transmit-receive type earth station. Explain each block in brief. 10
  - Differentiate between the following :— 5
      - Centralised Control System and Distributed Control System in DA-FDMA. 5
      - FH-CDMA and DS-CDMA.
    - List the different digital modulation techniques used in satellite communication, why BPSK or QPSK are the most widely used schemes ? Give suitable reasons. 10
  - It is decided to establish a satellite link (using transparent satellite) between two earth stations. The data are as follows :—

    - Uplink frequency,  $f_u = 14$  GHz
    - Downlink frequency,  $f_D = 12$  GHz
    - Downlink path loss,  $L_D = 206$  dB.

For Satellite :

    - Power flux density required to saturate the satellite channel amplifier,  $(\phi_{sat, i, om})_{SL} = -90$  dBW/m<sup>2</sup>
    - Gain on the axis of the receiving antenna,  $G_{Rmax} = 30$  dB
    - Figure of Merit  $(G/T)_{SL} = 3.4$  dBK<sup>-1</sup>
    - Channel amplifier characteristic (single carrier operation) modelled by—  
 $OBO(dB) = IBO(dB) + 6 - 6 \exp [ IBO(dB)/6 ]$
    - Effective isotropic radiated power at saturation,  $[ EIRP_{sat} ]_{SL} = 50$  dBW
    - Gain on the axis of the transmitting antenna,  $G_{Tmax} = 40$  dB.

The transmit and receive earth station are located at the centre of coverage. The following losses are considered :

    - $T_x$  and  $R_x - L_{FRX}$  and  $L_{FTX} = 0$  dB
    - Polarisation mismatch,  $L_{POL} = 0$  dB
    - Depointing losses,  $L_R = L_T = 0$  dB (ESat boresight)
    - Figure of Merit  $(G/T)_{ES} = 25$  dBK<sup>-1</sup>

Assume that there is no interference, calculate :

    - Satellite repeater gain at saturation 3
    - C/No for uplink and downlink and the overall link when the repeater operates at saturation. 5
    - Input back-off and output back-off to achieve 4  
 $(C/No)_T = 80$  dBHz and corresponding values of  $\left\{ \begin{array}{l} IBO = -16.4 \text{ dB} \\ OBO = -10.8 \text{ dB} \end{array} \right\}$   
 $(C/No)_{uplink}$  and  $(C/No)_{downlink}$
    - $(C/No)_T$  under rain conditions causing an attenuation of 6 dB on the uplink. 4
    - $(C/No)_T$  under rain conditions causing an attenuation of 6 dB on downlink with a reduction of 2 dB in figure of merit of Earth Station (ES) due to increase in antenna noise temperature  $(IBO = -13$  dB,  $OBO = -7.7$  dB). 4
  - Determine the limits of visibility of earth station situated at main sea level, at a latitude of 48-42°N and a longitude 89-26°W. Assume a minimum angle of elevation of 5°. 8
    - Describe the symmetrical, offset and the Cassegrain mounting of a parabolic reflector. 8
    - Discuss the effects of earths oblateness on the orbital incilination of a geosynchronous satellite. 4
  - Write short notes on (any four) :— 20

    - Single conversion and Double 10
    - 10
    - 10
    - 10