Code: D-17 Subject: ELEMENTS OF SATELLITE COMMUNICATION
Time: 3 Hours Max. Marks: 100

NOTE: There are 11 Questions in all.

Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.
Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x8)

    a.   A Satellite orbit is said to be polar if the inclination is

(A) $0°$. **(B)** $90°$.

    (C) $180°$. **(D)** $270°$.

    b.   For all practical purposes, the minimum elevation angle, required above the horizon by an earth station is

(A) atleast $5°$. **(B)** atleast $2°$.

(C) atleast $1°$. **(D)** atleast $3°$.

    c.   In the present day standard digital voice communication the amplitude of the voice signal is sampled at a rate of

(A) 1000 samples/sec. **(B)** 2000 samples/sec.
(C) 4000 samples/sec. **(D)** 8000 samples/sec.

    d.   For the same data rate, the energy per bit for QPSK will be
(A) the same as that for BPSK.
(B) one fourth of the energy per bit for BPSK.
(C) one half of the energy per bit for BPSK.
(D) three fourths of the energy per bit for BPSK.

    e.   The modulation index for a sinusoidal modulating signal with a frequency of 15 KHz for an FM broadcast transmitter operating at its maximum deviation of 75 KHz is

    (A) 4.2. **(B)** 6.3.
    (C) 5.0. **(D)** 3.0.

f. In specifying the performance of a receiving system, a key parameter is

    (A) EIRP. **(B)** $\left(G/T\right)$ ratio.
    (C) $\left(C/N\right)$ ratio as the receiver input. **(D)** Noise Factor.

g. In the Intelsat VI, the TDMA frame time is

(A) 4 ms. **(B)** 6 ms.
(C) 2 ms. **(D)** 8 ms.

h. DBS systems are operating in western countries since,
      (A) 1970 onwards. **(B)** 1975 onwards.
(C) 1982 onwards. **(D)** 1986 onwards.

PART I
Answer any THREE Questions. Each question carries 14 marks.

Q.2 a. How many frequency bands have been allocated for use with satellite communications? Which are they? Indicate the approximate downlink and uplink band of frequencies for the allocated bands. **(8)**

b. Considering a simple radio link, derive the equation for the power received by the receiving antenna. Also deduce the equation for the power attenuation in decibels. **(6)**

Q.3 a. Distinguish between an analog baseband signal and a digital baseband signal. Comment on the spectrum of a baseband voice signal as recommended by the CCITT. **(4)**

b. Define the term multiplexing. Distinguish between FDM & TDM. With neat sketches for illustration explain the FDM scheme for the satellite communication. **(10)**

Q.4 a. What are the main problems involved with the communication satellites regarding the orbit? **(2)**

b. What is a geostationary satellite? Estimate the orbital height above the equator for a geosynchronous satellite. **(8)**

c. Find the orbital period of a satellite 36000 Km above the earths surface. **(4)**

Q.5 a. What is the role played by an earth station in a satellite link? What are the requirements to be met by most of the earth stations? **(9)**

b. With a neat block schematic, explain the operation of the transmitter of an earth station. **(5)**

Q.6 a. How can satellite applications be broadly classified? **(5)**

b. Write a brief note on the following applications of satellite in the field of communication :

(i) Satellite TV.
(ii) Telephone service. **(9)**

PART II
Answer any THREE Questions. Each question carries 14 marks.

Q.7 a. What are the factors that make digital systems widely useful? Write the block schematic of a digital communication system and explain the function of each block. **(8)**

b. Write in brief the principle of BFSK technique. **(3)**

c. For the input binary sequence 110011, sketch the BFSK waveform given that the symbol 1 is represented by a signal of frequency $f_1 = 1.5/T_b$ and the symbol 0 by the signal having the frequency $\frac{0.5}{T_b}$. **(3)**

Q.8 a. What is multiple access as used in satellite communication? Indicate the different multiple access techniques used commonly for communication. **(3)**

b. With a sketch for illustration, briefly explain the principle of TDMA. **(5)**

c. Describe the TDMA frame structure. **(6)**

Q.9 a. What are the operations required for active attitude control? **(4)**

b. List the sensors used for attitude control in a communication satellite and briefly discuss their features. **(8)**

c. Calculate the $\left(G/T\right)$ ratio in dB for a receiving system with an antenna of gain 39.6 dB, antenna noise temperature of 39 Kelvin, and receivers noise temperature of 40 Kelvin. **(2)**

Q.10 a. Briefly describe the concept of disaster warning system of the INSAT. **(9)**

b. With a neat sketch illustrate the modern concept of a cable transmission network. **(5)**

Q.11 a. What is a VSAT? Discuss briefly its features. **(6)**

b. What are the requirements of the earth station antenna to provide efficient communication with the satellite? **(5)**

c. Calculate the gain of a 3m parabolic antenna operating at a frequency of 12 GHz. Assume an aperture efficiency of 0.55. **(3)**