Code: DE17 **Subject: ELEMENTS OF SATELLITE COMMUNICATION**
Time: 3 Hours **Max. Marks: 100**

DECEMBER 2007

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must 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 best alternative in the following: (2x10)

a. The frequency range of Ku band-commercial allocated for satellite communication – UPLINK is

(A) 250 – 270 MHz **(B)** 5925 – 6425 MHz
(C) 7250 – 7750 MHz **(D)** 14000 – 14500 MHz

b. The EIRP in dBW of a satellite link at 12GHz, operating with a transmit power of 6 W and an antenna gain of 48.2 dB is

(A) 22 dBW **(B)** 56 dBW
(C) 31.8 dBW **(D)** 100 dBW

c. The range between a ground station and a satellite is 42000 Km. If the speed of the radio wave is taken as 10^8 m/s, then the free-space loss at a frequency of 6 GHz will be

(A) 110.4 dB **(B)** 95.6 dB
(C) 200.4 dB **(D)** 213.6 dB

d. A standard NTSC signal has a baseband video bandwidth of 4.2 MHz and is transmitted over the satellite link in an RF bandwidth of 30 MHz using frequency modulation. The peak frequency deviation introduced for the signal is then equal to

(A) 9.3 MHz **(B)** 10.8 MHz
(C) 6.52 MHz **(D)** 13.4 MHz

e. The bandwidth of BFSK signal will be

(A) half that of the BPSK signal. **(B)** equal to that of the BPSK signal.
(C) twice that of the BPSK signal. **(D)** 1.5 times that of the BPSK signal.

f. The TDMA frame time of INTELSAT VI is

(A) 15 ms. **(B)** 20 ms.
(C) 250 μs. **(D)** 2 ms.

g. A communications satellite is to be placed in an equatorial orbit at a height of 40000 Km. The radius of the satellite from the surface of the earth is approximately equal to

(A) 46.3×10^5 m **(B)** 46.3×10^6 m
(C) 40.3×10^6 m **(D)** 42.3×10^6 m

h. For a paraboloidal reflector antenna used in SATCOMS, the approximate formula for its half-power beam width with usual notations is

(A) $\eta_I\left(\frac{\pi D}{\lambda}\right)^2$ **(B)** $70\frac{\lambda}{D}$

(C) $65\frac{\lambda}{D}$ **(D)** $70\frac{\lambda^2}{D}$

i. The $\left(\frac{G}{T}\right)$ ratio of VSAT systems is usually less than

(A) $15\,^{dB}/_{\circ K}$ **(B)** $40\,^{dB}/_{\circ K}$
(C) $70\,^{dB}/_{\circ K}$ **(D)** $90\,^{dB}/_{\circ K}$

j. The satellite frequency band allocation for X-band military (down link band) in MHz is approximately

(A) 250 to 270 **(B)** 20200 to 21200
(C) 292 to 312 **(D)** 7250 to 7750

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

Q.2 a. Illustrate the general structure of a satellite communication system and briefly explain. **(5)**

b. What are the external factors that constrain the development of satellite communication systems? Derive the equation for the power received by a real receiving antenna of physical receiving area A_r and effective aperture area of $A_e m^2$. **(7)**

c. A satellite radiates a power of 10 W from an antenna with a gain of 17 dB in the direction of the observer, find the flux density at the receiving point, and the power received by an antenna at this point with an effective area of 10 m^2. Take the distance of the satellite from a point on earth's surface as 40,000 Km. **(4)**

Q.3 a. Distinguish between an analog baseband signal and a digital baseband signal. What do you mean by the term 'multiplexing' as used in communication engineering? Briefly explain the type of multiplexing technique for analog communications. **(8)**

b. Comment on the use of frequency modulation in satellite analog communication links. Write a note on FM threshold. **(8)**

Q.4 a. What are the advantages of digital communication? Write in brief about 'baud' that you know. **(6)**

b. What is phase shift keying? Briefly describe BPSK. **(6)**

c. With a block schematic for illustration, briefly explain the principle of TDMA. **(4)**

Q.5 a. Distinguish between single access and multiple access. What is TDMA? What do you understand from a signal called TDM-TDMA? **(7)**

b. Briefly explain the TDMA frame structure. **(6)**

c. Distinguish between 'fixed assignment' and 'demand assignment'. How do you compare the two systems? **(3)**

Q.6 a. State and briefly explain the three Kepler's laws. **(8)**

b. A satellite moving in an eccentric elliptical orbit has semi-major axis and semi-minor axis of 'a' and 'b' respectively and an eccentricity of 0.6. The satellite takes 3 hours and 10 minutes in moving from B to A in the direction shown. What will be the time taken by the satellite to move from A to B in the direction shown in the Fig.1. **(8)**

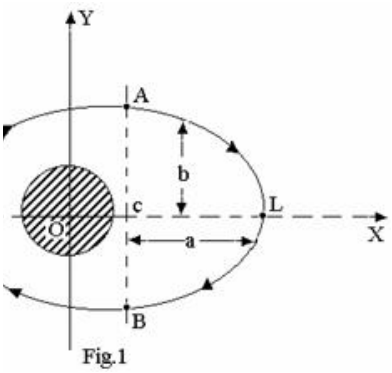

Fig.1

Q.7 a. What are the operations required for active altitude control? Briefly comment on how the operations are carried out in practice. **(8)**

b. Which are the elements that constitute the communication subsystem of a COMSAT? What do they provide? Write a brief note on the thermal control sub-system. **(8)**

Q.8 a. What is an earth station as used in satellite communication? How are they classified? List the important requirements to be met by earth stations. **(10)**

b. What are VSATS? Comment in brief on two of their major applications. **(6)**

Q.9 Briefly explain the following:

(i) INMARSAT. **(5)**
(ii) Overall capacity requirements for INSAT-II. **(6)**
(iii) Cartography. **(5)**