Code: DE-17 **Subject: ELEMENTS OF SATELLITE COMMUNICATION**

JUNE 2007

Time: 3 Hours **Max. Marks: 100**

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 specialised agency which has developed radio regulations for frequency allocations international wise for different purposes is

(A) CCITT **(B)** CCIR
(C) ITU **(D)** IFRB

b. As per CCITT recommendations, the spectrum of a baseband voice signal is

(A) 300 to 3100 KHz **(B)** 300 to 3000 Hz
(C) 3000 to 3400 Hz **(D)** 8 to 10 KHz

c. A test tone of frequency 800 Hz is used to frequency – modulate a carrier. If the peak deviation is 200 KHz, then the bandwidth will be

(A) 300 KHz **(B)** 200 KHz
(C) 362.6 KHz **(D)** 401.6 KHz

d. The power in a QPSK signal is

(A) $\frac{A}{\sqrt{2}}$ **(B)** $\frac{A^2}{\sqrt{2}}$
(C) $\frac{A^2}{2}$ **(D)** None of the above.

e. If the value of the eccentricity equals one, then the type of orbit is

(A) circle **(B)** ellipse
(C) hyperbola **(D)** parabola

f. The gain of a 3-m parabolic antenna operating at a frequency of 12 GHz, for an aperture efficiency of 0.5 is

(A) 42.3 dB **(B)** 35.28 dB
(C) 52.32 dB **(D)** 48.9 dB

g. HPAs using GaAs FET device can provide power in

(A) 100 to 200 KW range **(B)** 30 to 50 KW range
(C) 600 to 800 W range **(D)** 1 to 6 W range

h. Typical value of the antenna diameter for the home set of DBS system will be of the order of

(A) 3 m **(B)** 0.6 m
(C) 5 m **(D)** none of the above

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

(A) 32 dBW **(B)** 72.5 dBW
(C) 56 dBW **(D)** 50.23 dBW

j. If the sum of the apogee and perigee distances of a certain elliptical satellite orbit is 50000Km and the difference of the apogee and perigee distances is 40000Km, then the target eccentricity will be

(A) 8 **(B)** 0.8
(C) 0.4 **(D)** 0.6

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

Q.2 a. What are communication satellites? How are they classified? Mention two advantages of communication satellites. Name the frequency bands that have been allocated for use with satellite communication. **(8)**

b. Deduce the equation for the power received by the receiving station in a SATCOM link. **(6)**

c. An earth station uses an antenna of gain 60.6 dB. If the system noise temperature is 79 K at the frequency of operation, compute the G/T ratio of the earth station. **(2)**

Q.3 a. Write the equation for the output SNR for frequency modulation in a satellite link for the case of a non-sinusoidal modulating signal, whose spectrum extends from 0 to f_{max} Hz. Comment on

each term of the above relation. What do you understand from the above equation as regards the improvement in $(S/N)_o$ value is concerned? **(8)**

b. Write a note on FM threshold. **(5)**

c. Write three important points about SCPC technique. **(3)**

Q.4 a. What are the advantages of digital transmission techniques that have gained increased usage for satellite communication? What is it that has made the digital techniques quite successful? **(7)**

b. With a neat schematic explain the features of a digital communication system. **(9)**

Q.5 a. Write a note on the antenna subsystem. **(9)**

b. Determine the power gain of a paraboloid reflector antenna with a mouth diameter of 10m at 6GHz. Assume antenna aperture efficiency to be 80%. **(7)**

Q.6 a. State the three Kepler's laws. Give the geometry of an elliptical orbit of communication satellite and write the equations for the following orbital parameters:
(i) Eccentricity (ii) Semimajor axis
(iii) Apogee distance (iv) Perigee distance **(12)**

b. A satellite is in an elliptical orbit with a perigee of 1000 Km and an apogee of 4000 Km. If the mean earth radius is 6378.14 Km, find the period of the orbit in hours, minutes, and seconds. **(4)**

Q.7 a. Name the different subsystems on board the spacecraft. **(4)**

b. Briefly explain the communications sub-system of a typical satellite. **(12)**

Q.8 a. List the important requirements that most of the earth stations should meet. **(7)**

b. Briefly explain the following:

(i) Satellite TV.
(ii) VSATs. **(9)**

Q.9 Explain briefly the following:

(i) CATV. **(5)**

(ii) Oceanography – a satellite based application related to earth's observation. **(5)**

(iii) DBS system. **(6)**