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. The first Indian communication experimental satellite was launched in

(A) March 1987. **(B)** August 1983.
(C) June 1981. **(D)** July 1988.

b. For an FM modulator with a deviation constant of 30 KHz / volt and operating at a carrier frequency of 175 MHz, the output frequency for an instantaneous value of the modulating signal equal to 150 mV is

(A) 172.001 MHz. **(B)** 173.004 MHz.
(C) 175.004 MHz. **(D)** 177.003 MHz.

c. For the control of Indian remote sensing satellite series, the ISRO telemetry, tracking and command network has established a multi-mission space-craft control centre at

(A) PORT BLAIR. **(B)** SHAR.
(C) BANGALORE. **(D)** MAURITIUS.

d. The high power amplifier used in a VSAT employs

(A) a TWT. **(B)** a Tunnel diode.
(C) a BJT. **(D)** a GaAs FET.

e. The K-band covers

(A) 24 to 40 GHz. **(B)** 18 to 24 GHz.
(C) 9 to 17 GHz. **(D)** 2 - 4 GHz.

f. The SUN sensors can measure the angle between the direction of the sun and an axis related to the satellite within a tolerance of about

(A) 0.002°. **(B)** 0.009°.
(C) 0.005°. **(D)** 0.007°.

g. The INMARSAT origin was established in

(A) 1960. **(B)** 1970.
(C) 1975. **(D)** 1979.

h. The altitude of medium-earth-orbit satellites range from

(A) 300 to < 1500 Km. **(B)** 1500 to < 5000 Km.
(C) 8000 to 20000 Km. **(D)** 5000 to < 8000 Km.

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

Q.2 a. Give the general structure of a satellite communication system in a block schematic form and briefly explain the operation. **(6)**

b. Which is the important parameter that governs the performance of a satellite receiver? Derive the equation for the carrier-to-noise ratio at the demodulator input of a receiver. **(5)**

c. Fig.1 shows a cascaded arrangement of three gain blocks. Determine the equivalent noise temperature of the cascaded arrangement, T_e. **(3)**

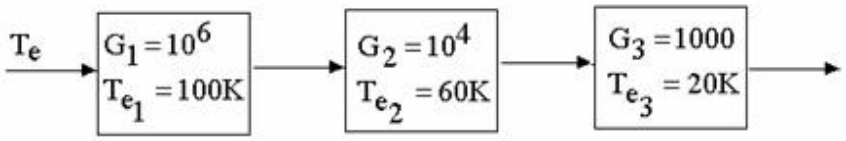

Fig.1

Q.3 a. Why frequency modulation is used in satellite analog communication links? Name the quantity which serves as a measure of the performance of a conventional FM receiver in the presence of random noise and write the expression for the same. Comment on the significance of the above expression with a neat sketch for illustration. **(10)**

b. An FM signal has a deviation of 3 KHz and a modulating frequency of 1 KHz. Its total power is 5 W developed across a 50Ω resistive load. If the carrier frequency is 160 MHz, calculate
(i) the r.m.s. signal voltage.
(ii) The bandwidth of the signal. **(4)**

Q.4 a. With a neat sketch illustrate the geometry of an elliptical orbit of communication satellite. Mention the range of values of the eccentricity 'e' for different types of orbits. **(6)**

b. For the elliptical orbit of part (a) above, write the equations for the following:
(i) eccentricity (ii) semi major axis
(iii) semi minor axis (iv) apogee and perigee distances. **(5)**

c. A satellite moving in an elliptical concentric orbit has the semi major axis of the orbit equal to 16000 Km. If the difference between the apogee and the perigee is 30000 Km, determine the orbit eccentricity. **(3)**

Q.5 a. How are earth stations classified? Name the important categories of earth stations. Mention their features, types of service and a feature that is common to all earth stations. **(9)**

b. Draw the basic block diagram of an earth station receiver and briefly explain its operation. **(5)**

Q.6 a. What is the difference between a conventional satellite transponder and a regenerative satellite transponder?

Which are the building blocks that make the communication subsystems of a communication satellite? What is the function of this subsystem? **(5)**

b. What is TDM? Define the process of commutation with reference to TDM. Illustrate the principle of TDM by a neat figure. **(3)**

c. Write a note on the application of satellite for weather forecasting. **(6)**

PART II

Answer any THREE Questions. Each question carries 14 marks.

Q.7 a. What is digital modulation? Explain in brief the principle of BPSK and QPSK techniques. **(8)**

b. If QPSK symbols are Gray encoded as
dibit 00 = Phase shift of 'o' radian
dibit 01 = Phase shift of $'\frac{\pi}{2}'$ radians
dibit 10 = Phase shift of $'\frac{3\pi}{2}'$ radians
dibit 11 = Phase shift of $'\pi'$ radians and if the carrier frequency is $'f_c'$, find the four sinusoidal transmitted signals.
(Note : a dibit is a pair of bits) **(6)**

Q.8 a. What are the methods used for assigning channels to the users in a multiple access technique? Define and briefly discuss their features. **(10)**

b. What are the advantages of spread spectrum techniques? **(4)**

Q.9 a. What are the functions of the antennas aboard a satellite? What is the type of antenna pattern required in satellite communication? **(6)**

b. Write a note on the antennas used in the communication satellite subsystem. **(8)**

Q.10 a. Mention the agencies which use INSAT-II and write a note on the overall capacity requirements for INSAT-II. **(9)**

b. What is a DBS system? Briefly explain the operation of a DBS system. **(5)**

Q.11 a. What are look angles? How are they calculated? **(4)**

b. Explain the features of the paraboloid antenna with a focal point feed used in earth stations. **(7)**

c. A satellite down link at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW. **(3)**