SATELLITE COMMUNICATION AND APPLICATIONS
(ECEN 5141)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Inclination is the angle that the orbital plane makes with the
(a) Earth's equatorial plane (b) Sun's equatorial plane
(c) Moon's orbital plane (d) Apogee.

(ii) A satellite beam that covers almost 42.4% of the earth's surface is called
(a) Zone beam (b) Hemispheric beam
(c) Spot beam (d) Global beam.

(iii) A satellite having a very high value of inclination is called a
(a) Polar satellite (b) Molniya satellite
(c) Geostationary satellite (d) None of these.

(iv) As rain attenuation rarely exceeds 1 to 2dB 99.99% reliable design can be done with
(a) C band (b) Ka band
(c) Ku band (d) L band.

(v) The satellite subsystem that ensures that the antenna remain pointed towards a fixed point on the earth is:
(a) Attitude and orbit control subsystem (b) TT & C subsystem
(c) Antenna subsystem (d) Structural subsystem

(vi) The quality of a space-link is measured in terms of the
(a) C/N ratio (b) S/N ratio
(c) G/T ratio (d) EIRP

(vii) EIRP is normally employed to express the
(a) Transmitted power of the earth station antenna
(b) Received power of the earth station antenna
(c) Gain of the earth station antenna
(d) None of these

(viii) The band that is commonly used for satellite communication is
(a) 6/4 GHz (b) 13/9 GHz
(c) 9/5 GHz (d) 20/15 GHz.

(ix) The part of the GPS signal structure that contains information on the position of the satellite at any given time is
(a) Ephemeris data (b) Pseudorandom code
(c) Almanac data (d) None of these.

(x) In satellite communication for a communication channel using a 36MHz transponder bandwidth, the IF frequency chosen is
(a) 70 MHz (b) 140 MHz
(c) 80 MHz (d) 36 MHz.

Fill in the blanks with the correct word

(xi) The orbit eccentricity e is the ratio of the distance between the center of the ellipse and the center of the earth to the _____ axis of the ellipse.

(xii) The satellite orbits can be classified on the basis of orientation of orbital plane, _____ & distance from earth

(xiii) The coordinates to which an Earth station antenna must be pointed to communicate with a satellite are called the _____ _____.

(xiv) _____ _____ is by far the most important of various losses for frequencies above 10 GHz.

(xv) Talk and listen nature of a normal two way conversation keeps one direction of line idle for _____ percent.

Group - B

2. (a) Define True Anomaly of satellite orbit and Mean Anomaly with proper diagram.
[(CO1)(Remember/LOCQ)]

(b) A satellite is moving in an elliptical orbit with the major axis equal to 52000km. If the perigee distance is 16000Km find the apogee and the orbit eccentricity.
[(CO1)(Apply/IOCQ)]

(c) Differentiate between Geosynchronous and Geostationary orbit.
[(CO1)(Analyse/IOCQ)]

4 + 4 + 4 = 12

3. (a) The elliptical orbit of a satellite has its semi-major and semi-minor axes as 25000 km and 18330 km respectively. Determine the apogee and perigee distances.
[(CO1)(Evaluate/HOCQ)]

(b) Define the term look angles and subsatellite point with proper diagram?
[(CO1)(Remember/LOCQ)]

(c) Describe the process of placing geostationary satellites in their orbit with proper diagram.
[(CO1)(Understand/LOCQ)]

4 + 4 + 4 = 12

Group - C

4. (a) Analyse the effects of attenuation caused by rain on the transmission of signals in satellite communication. *[(CO2)(Analyse/IOCQ)]*

   (b) What is Link Budget? How are they utilized to design satellite links? *[(CO2)(Apply/HOCQ)]*

6 + (2 + 4) = 12

5. (a) A satellite at a distance of 40,000 Km from a point on the earth's surface radiates a power of 10W from an antenna with a gain of 17dB 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 $10m^2$. *[(CO2)(Evaluate/HOCQ)]*

   (b) Analyse different types of interference that occur during transmission of signals in satellite communication. *[(CO2)(Analyse/IOCQ)]*

4 + 8 = 12

Group - D

6. (a) Differentiate between FDMA and TDMA. *[(CO3)(Analyse/IOCQ)]*

   (b) The total number of bits in a TDMA frame is 1800000 and the frame efficiency is 98.72%. If the traffic data rate in a PCM encoded voice channel is 64kbps determine the maximum number of voice channels carried in a frame. Consider the length of TDMA frame to be 20ms. *[(CO3)(Evaluate/HOCQ)]*

   (c) DSI becomes more efficient as the number of channels increases - Justify. *[(CO4)(Analyse/IOCQ)]*

4 + 4 + 4 = 12

7. (a) What is meant by DAMA? How is it being used by multiple users to share a common link? *[(CO4)(Understand/IOCQ)]*

   (b) Write a brief note on satellite packet communication. *[(CO4)(Remember/LOCQ)]*

(2 + 4) + 6 = 12

Group - E

8. (a) What is VSAT? Describe a typical VSAT network with diagram. *[(CO5)(Remember/LOCQ)]*

   (b) Differentiate between star topology and mesh topology. *[(CO5)(Analyse/IOCQ)]*

(2 + 4) + 6 = 12

9. (a) Discuss briefly the GPS signal structure used for satellite communication. *[(CO6)(Remember/LOCQ)]*

   (b) In GPS position of any receiver is determined by calculating its distance from four satellites-Justify? *[(CO6)(Analyse/IOCQ)]*

   (c) What is the function of the control system of GPS? *[(CO6)(Understand/LOCQ)]*

4 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	50	18.75

Course Outcome (CO):

After the completion of the course students will be able to
1. Describe and explain about the orbits, different parameters of a satellite system and subsystems.
2. Discuss about earth stations, satellite transponder and satellite links design.
3. Explain and compare different Multiple Access Techniques.
4. Analyze DAMA, Speech interpolation and Satellite packet communication.
5. Compare propagation effects, VSAT systems, Direct Broadcast Television and Radio.
6. Assess Mobile satellite network, Satellite Navigation and the global positioning system.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*