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) The point of intersection of satellite's orbital plane and equatorial plane where the satellite enters from northern hemisphere into southern hemisphere is called as
(a) Ascending node (b) Perigee
(c) Apogee (d) Descending node.

(ii) "The line joining the satellite and centre of Earth spans equal areas in equal intervals of time" is the statement contained in which of the following option?
(a) Kepler's first law (b) Kepler's second law
(c) Kepler's third law (d) Newton's law of gravitation.

(iii) The most widely used frequency spectrum in the 6/4 GHz band with an uplink of
(a) 5GHz-7GHz (b) 5.5 GHz -7.5GHz
(c) 5.2 GHz-5.8 GHz (d) 5.725 GHz-7.075GHz

(iv) The duration of satellite eclipses is maximum during
(a) Solstices (b) Equinoxes
(c) Both during equinoxes and solstices (d) None of these

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

(vi) Telephone load activity factor calculated through DSI technique is
(a) 0.35 (b) 0.25 (c) 0.75 (d) 0.45

(vii) Ionosphere scintillation refers to
(a) Faraday rotation (b) Amplitude and phase variation
(c) Troposcatter (d) Multipath effects.

(viii) GPS system consists of x number of satellites, where x stands for
(a) 3 (b) 12 (c) 24 (d) 36

(ix) Spatial resolution of weather satellites is of the order of
(a) 10-100 cm (b) 1-10 km
(c) 100-500 km (d) 1-10 m

(x) What does the "L1" in GPS L1 frequency refer to?
(a) The first satellite launched
(b) A signal processing algorithm
(c) A frequency band used for civilian GPS signals
(d) A tracking station on Earth.

Fill in the blanks with the correct word

(xi) _____ is the point on the satellite orbit that is the farthest distance from the centre of the Earth.

(xii) The Global Positioning System (GPS) primarily uses _____ orbit satellites.

(xiii) The part of a satellite that receives, amplifies, and retransmits signals back to Earth is called the _____.

(xiv) A _____ is used in satellite communication to convert the high-frequency signal received from the satellite down to a lower frequency for processing.

(xv) In satellite communication, the _____ is the part of the satellite that carries the equipment for communication, such as transponders, antennas, and sensors.

Group - B

2. (a) Define Right Ascension of Ascending Node and Argument of the perigee with proper diagram. *[(CO1)(Remember/LOCQ)]*
(b) A satellite is moving in an elliptical orbit with the major axis equal to 42000km. If the perigee distance is 8000 Km, find the apogee and the orbit eccentricity. Define inclination of an orbit. *[(CO1)(Remember/LOCQ)]*

(3 + 3) + (4 + 2) = 12

3. (a) Discuss the typical frequency bands used in satellite communication. Explain why is uplink frequency kept higher than downlink frequency. *[(CO2)(Understand/LOCQ)]*
(b) Briefly describe the satellite communication sub-system for a 6/4 GHz band. *[(CO2)(Understand/LOCQ)]*

(3 + 3) + 6 = 12

Group - C

4. (a) Define antenna gain to noise temperature (G/T) ratio. *[(CO2)(Remember/LOCQ)]*
(b) Briefly describe the major sources that can cause interference in a satellite link both to the reception at the satellite and the Earth station. *[(CO2)(Understand/LOCQ)]*
(c) Compute the free-space path loss in decibels for the following conditions:
(i) For a path length of 10 km at 4 GHz operating frequency.

(ii) Earth station transmitting antenna EIRP = 50 dbW, satellite receiving antenna gain = 20 db and received power at satellite = -120 dbW

[(CO2)(Apply/IOCQ)]

3 + 5 + (2 + 2) = 12

5. (a) Classify the Earth stations on the basis of services provided by them. Briefly describe features and facilities of each one of them. *[(CO3)(Analyse/IOCQ)]*

(b) With the help of a block diagram, briefly describe the functions of the important constituent parts of a typical large size Earth station. *[(CO3)(Understand/LOCQ)]*

6 + 6 = 12

Group - D

6. (a) Briefly describe the operational principle of a frequency division multiple access (FDMA) system. *[(CO3)(Understand/LOCQ)]*

(b) Explain the significance of guard band. *[(CO3)(Understand/LOCQ)]*

(c) Distinguish between single channel per carrier and multi-channel per carrier types of FDMA systems. *[(CO3)(Analyze/LOCQ)]*

5 + 3 + 4 = 12

7. (a) A geostationary satellite has a round trip propagation delay variation of 40 ns/s due to station-keeping errors. If the time synchronization of DS-CDMA signals from different Earth stations is not to exceed 20% of the chip duration, determine the maximum allowable chip rate so that a station can make correction once per satellite round trip delay. Assume satellite round trip delay to be equal to 280 ms. *[(CO3)(Analyse/IOCQ)]*

(b) Explain the difference between a traffic burst and a reference burst in a TDMA system. *[(CO3)(Analyze/IOCQ)]*

(c) Analyze the impact of using smaller cell sizes on frequency reuse in an SDMA-based network. *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Compute the free-space path loss in decibels for the following conditions:
(i) For a path length of 10 km at 4 GHz operating frequency.
(ii) Earth station transmitting antenna EIRP = 50 dBW, satellite receiving antenna gain = 20 dB and received power at satellite = -120 dBW.

[(CO5)(Apply/IOCQ)]

(b) Define VSAT. *[(CO4)(Remember/LOCQ)]*

(c) Describe a typical VSAT network with diagram. *[(CO4)(Understand/LOCQ)]*

(2 + 2) + 3 + 5 = 12

9. (a) Identify which type of orbit “polar” or “geostationary” is more commonly used for weather forecasting applications? Justify the reason. Give examples of specific weather satellites that use each type of orbit. *[(CO6)(Apply/IOCQ)]*

(b) Explain the concept of remote sensing with special emphasis on remote sensing using satellites. *[(CO5)(Understand/LOCQ)]*

(2 + 4) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	66	34	0