SATELLITE COMMUNICATION AND APPLICATIONS
(ECEN 5141)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) 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-7.075 GHz.

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

(iii) Whole GPS subsystem around the globe comprises of
(a) 66 satellites (b) 32 satellites (c) 28 satellites (d) 16 satellites.

(iv) In case of Geostationary satellites, the inclination of the orbit increases at an average rate of about
(a) 0.85^o per year (b) 1^o per year (c) 0.65^o per year (d) 1.85^o per year.

(v) The location on the surface of the earth that lies directly between the satellite and the centre of the earth is called
(a) Zenith (b) Sub-satellite point
(c) Look angle (d) Elevation.

(vi) Spinning the satellite and momentum wheels are techniques to make a satellite
(a) stable in its orbit (b) rotate in its orbit
(c) move aside from its orbit (d) both (i) and (ii).

(vii) When wide beams are required for global coverage, the type and antenna that is used for
(a) Horn antenna (b) Reflector antenna
(c) Phased antenna (d) Wire antenna.

(viii) GPS satellites transmit signals on two microwave frequencies of
(a) 1475.23 MHz & 1227.60 MHz (b) 1575.23 MHz & 1127.60 MHz
(c) 1575.42 MHz & 1227.60 MHz (d) 1675.23 MHz & 1227.60 MHz.

(ix) 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) both Ku and Ka band.

(x) The correct position of each satellite in GPS is obtained from
(a) Almanac data (b) Pseudorandom code
(c) Transponder code (d) Ephemeris data.

Group - B

2. (a) Analyse GEO, MEO, and LEO satellites with their category of services.
[Analyse, (CO1/IOCQ)]
(b) A satellite is moving in an elliptical orbit with the major axis equal to 42000 km. If the perigee distance is 8000 km, find the apogee and the orbit eccentricity.
[Evaluate, (CO1/HOCQ)]
(c) Differentiate between geosynchronous and geostationary orbits.
[Analyse, (CO1/ IOCQ)]
4 + 4 + 4 = 12

3. (a) Analyse the effect of Sun and Moon on the satellite orbit. [CO1,(Analyse/IOCQ)]
(b) A satellite, moving in an elliptical orbit, is 420 km above earth's surface at its farthest point and 210 km above at its closest point. Evaluate the eccentricity of the orbit.
[CO1,(Evaluate/HOCQ)]
(c) Analyse elevation angle and azimuth angle and evaluate their expressions.
[CO1,(Evaluate/HOCQ)]
3 + 6 + 3 = 12

Group - C

4. (a) Discuss the different types of satellite launch vehicles. [CO2,(Understand/LOCQ)]
(b) Draw the schematic block diagram of the satellite communication system and evaluate the function of each block. [CO2,(Evaluate/HOCQ)]
6 + 6 = 12

5. (a) The uplink carrier to noise ratio can be calculated if the carrier EIRP is given-Justify.
[(CO2)(Analyse/IOCQ)]
(b) A geostationary satellite at a distance of 36000 km from the surface of the earth radiates a power of 10 W in the desired direction through an antenna having a gain of 20 dB. What would be the power density at a receiving site on the surface of earth station and also the power received by an antenna having an effective aperture of 10 m^2?
[(CO2)(Evaluate/HOCQ)]
6 + 6 = 12

Group - D

6. (a) Analyze the characteristics of digital speech interpolation. [(CO4)(Analyze/IOCQ)]

(b) Distinguish the features between the centralized control DAMA and distributed control DAMA. [(CO4)(Analyse/IOCQ)]

6 + 6 = 12

7. (a) Write the Erlang B formula for call congestion and explain it. [(CO4)(Understand/LOCQ)]

(b) DSI is employed in TDMA where on an average each channel is free for 60% of the time if we consider the practical scenario — Justify. [(CO4)(Analyse/IOCQ)]

(c) A traffic intensity of 1 Erlang is offered to a group of 3 channels. The average holding time is 2 mins. Calculate the following:

(i) The average number of call arrivals per hour.

(ii) The probability that no call will arrive during a specified period of 2 mins.

(iii) The probability that a call will be blocked. [(CO4)(Evaluate/HOCQ)]

3 + 3 + 6 = 12

Group - E

8. (a) Describe the working principle of GPS with proper diagram. [(CO6)(Understand/LOCQ)]

(b) Differentiate between the Point Positioning and Relative Positioning of GPS systems. [(CO6)(Analyse/IOCQ)]

8 + 4 = 12

9. (a) Mention the major phenomena that lead to signal losses in transmission. [(CO5)(Remember/LOCQ)]

(b) Depolarization of signals causes signal interference during propagation – Justify. [(CO5)(Analyse/IOCQ)]

(c) Describe the star and mesh topologies used in VSAT. [(CO5)(Remember/LOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26.04	35.42	38.54

Course Outcome (CO):

After the completion of the course students will be able to

1. Students will know about the orbits and different modules of a satellite.
2. They will have knowledge about satellite links and various factors affecting the QOS of the links.
3. The students will be able to explain the differences between TDMA, FDMA, DAMA etc. access techniques.

4. They will be able to explain VSAT, GPS
5. The students will be able to analyze causes of interference and solution.
6. They will understand GPS working.

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