

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 path that is not periodically revisited by a satellite is called
 - (a) trajectory
 - (b) orbit
 - (c) mascons
 - (d) monliya
 - (ii) 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
 - (iii) The subsystem that monitors and controls the satellite is
 - (a) Power subsystem
 - (b) Communication subsystem
 - (c) TT&C
 - (d) Propulsion subsystem
 - (iv) Whole GPS subsystem around the globe comprises of
 - (a) 66 satellites
 - (b) 32 satellites
 - (c) 28 satellites
 - (d) 16 satellites
 - (v) Subsatellite point lies directly between the satellite and center of the
 - (a) Earth station
 - (b) Earth
 - (c) Moon
 - (d) Equatorial plane
 - (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) The link between the gateway station and the mobile terminal is defined as the:
 - (a) Out bound link
 - (b) Inbound link
 - (c) Duplex link
 - (d) None of these
 - (viii) The satellite used in GPS are placed in
 - (a) Circular MEO orbits
 - (b) Elliptical MEO orbits
 - (c) Circular GEO orbits
 - (d) Elliptical GEO orbits

- (ix) The ability of the earth station to hop its carrier from transponder to transponder is referred to as
- | | |
|-------------------------|---------------------|
| (a) frequency hopping | (b) carrier hopping |
| (c) transponder hopping | (d) channel hopping |
- (x) Single-channel-per-carrier systems are more suitable for applications that require
- | | |
|-----------------------------|----------------------------|
| (a) single channel per link | (b) few channels per link |
| (c) dual channels per link | (d) many channels per link |

Group - B

2. (a) Define Ascending and Descending Nodes with respect to satellite orbit. [(CO1) (Remember/LOCQ)]
- (b) The apogee and perigee distances of a satellite orbiting in an elliptical orbit are 45000Km and 7000Km respectively. Determine the following:
- (i) Semi major axis of the elliptical orbit.
 - (ii) Orbit eccentricity.
 - (iii) Distance between the center of the earth and centre of the elliptical orbit. [(CO1) (Evaluate/HOCQ)]
- (c) Why subsatellite point plays an important role to locate a satellite? [(CO1) (Analyse/IOCQ)]
- 4 + 6 + 2 = 12**
3. (a) Analyse the effect of Sun and moon on the satellite orbit. [CO1, (Analyse/IOCQ)]
- (b) Verify that a geostationary satellite needs to be at a height of about 35780km above the earth's surface. Assume the radius of the earth to be 6380km and $\mu=39.8 \times 10^{13} \text{ N-m}^2/\text{kg}$. [CO1, (Evaluate/ HOCQ)]
- (c) A typical monliya orbit has perigee and apogee heights above the surface of the earth as 400 km and 40000 km respectively. verify that the orbit has a 12hour time period assuming radius of earth to be 6380km and $\mu=39.8 \times 10^{13} \text{ N-m}^2/\text{kg}$. [CO1, (Evaluate/ HOCQ)]
- 4 + 4 + 4 = 12**

Group - C

4. (a) Draw the block diagram of 14/11GHz transponder and explain the process of double frequency conversion briefly. [(CO2) (Remember/LOCQ)]
- (b) Why redundancy configuration is necessary in case of HPA? [(CO2) (Analyse/IOCQ)]
- (c) Derive the transmission equation for satellite communication including all types of losses that may occur during signal transmission. [(CO3) (Analyse/IOCQ)]
- 4 + 4 + 4 = 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 20dB. What would be the power density at a receiving site on the surface of earth and also the power received by an antenna having an effective aperture of 10m²? [CO2, Evaluate/HOCQ]
- (c) Why link budgets are important for satellite communication?
[CO2, (Analyse/IOCQ)]
6 + 4 + 2 = 12

Group - D

6. (a) The non-linear device contains undesirable frequencies like the IM products which fall within the transponder bandwidth-Justify. [(CO3) (Analyse/IOCQ)]
- (b) Why SC-PC systems are more suitable for applications that require only a few channels per link. [(CO3) (Analyse/IOCQ)]
- (c) Define Frequency division Multiplexing access. [(CO3) (Remember/LOCQ)]
8 + 2 + 2 = 12
7. (a) Distinguish between multiplexing and multiple access. [CO3, (Analyse/IOCQ)]
- (b) Find the time duration of a bit if the data is transmitted at 270.833kbps in the channel of a TDMA frame. [CO3, (Evaluate/HOCQ)]
- (c) Find out the BW of a TDMA forward link if each channel has BW of 200KHz with 8 speech channels per radio channels. Design the systems for a total of 1000 & 2000 simultaneously. [CO3, (Evaluate/HOCQ)]
4 + 2 + 6 = 12

Group - E

8. (a) Differentiate between the unidirectional star, bidirectional star and mesh topologies used in VSAT. [CO4, (Analyse/IOCQ)]
- (b) Why GPS satellites are placed in MEO orbits. [CO3, Analyse/IOCQ]
- (c) Write a short note on speech interpolation. [CO3, (Remember/LOCQ)]
6 + 3 + 3 = 12
9. (a) How depolarization of signals causes signal interference during propagation. [(CO5) (Analyse/IOCQ)]
- (b) Write briefly about the TVRO and DBS systems used in DTH satellite television. [(CO6) (Remember/LOCQ)]
- (c) Describe the role of NCC in Mobile satellite network configuration. [(CO6) (Remember/LOCQ)]
4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.37%	40.62%	25%

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.

Department & Section	Submission Link
ECE	https://classroom.google.com/w/NDE1MzkzNzM5MTEw/tc/NDY4MTg4NzUzMjYz