

CS / M.TECH (ECE) / SEM-2 / MCE-205-A / 2011
2011
SATELLITE COMMUNICATION
Time Allotted: 3 Hours
Full Marks : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. 1 and any four questions from the rest.

1. Choose the correct alternatives for any ten of the following :

$$
10 \times 1=10
$$

i) In a TDMA frame total frame length is 15 ms and overhead portion of the frame is 3 ms . Find the frame efficiency
a) $78 \%$
b) $80 \%$
c) $60 \%$
d) $70 \%$.
ii) Satellites are always launched towards
a) east
b) west
c) north
d) south.
iii) To make satellite visible from an earth station the maximum angular separation between the earth station \& the sub-satellite point is limited by
a) $\gamma \leq \cos ^{-1}\left(r_{e} / r_{s}\right)$
b) $\quad \gamma>\cos ^{-1}\left(r_{e} / r_{s}\right)$
c) $\gamma=\cos ^{-1}\left(r_{e} / r_{s}\right)$
d) $\quad \gamma \geq \cos ^{-1}\left(r_{e} / r_{s}\right)$.

CS / M.TECH (ECE) / SEM-2 / MCE-205-A / 2011
iv) Which system of satellite is known asa Iridum satellites ?
a) LEO
b) MEO
c) GEO
d) HEO .
v) Earth station figure-of-merit is defined as
a) $10 \log [\mathrm{G} / \mathrm{T}]$
b) $10 \ln [\mathrm{G} / \mathrm{T}$ ]
c) $10 \log \mathrm{GT}$
d) $20 \log [G / T]$.
vi) In the $C$ band transponders downlink frequency is about
a) 6 GHz
b) 4 GHz
c) 11 GHz
d) 14 GHz .
vii) Satellite capacity depends on
a) weight that can be placed in orbit
b) panel area available for energy dissipation
c) transmitter power
d) all of these.
viii) The satellite velocity is $\qquad$ at the perigee point.
a) minimum
b) maximum
c) nil
d) none of these.
ix) A satellite earth station antenna has a gain of $10^{6}$ and a noise temperature of $100^{\circ} \mathrm{K}$. The earth station (G/T) in $\mathrm{dB} /$ Kelvin is
a) $40 \mathrm{~dB} / \mathrm{K}$
b) $80 \mathrm{~dB} / \mathrm{K}$
c) indeterminate
d) $20 \mathrm{bdB} / \mathrm{K}$.
$\mathrm{x})$ In the $C$ band transponders uplink frequency is about
a) 8 GHz
b) 4 GHz
c) $\quad 6 \mathrm{GHz}$
d) none of these.
xi) One of the following satellites is in a highly eccentric, inclined orbit
a) Molniya series
b) Raduga
c) Ekran
d) Gorizont.

xii) The range between a ground station and a satellite is 42000 km , the free space loss in dB at 6 GHz will be
a) 200.4 dB
b) 100 dB
c) $104 \cdot 2 \mathrm{~dB}$
d) 250 dB .
xiii) Retrograde orbits have inclination angle
a) 90 degree
b) $>90$ degree
c) zero degree
d) < 90 degree.
xiv) Inter-modulation noise occurs in
a) receiving antenna
b) mixer circuit
c) transponder circuit
d) solar panels.
2. a) Discuss different types of satellites LEO, MEO, HEO and GEO.
b) What is the difference between geostationary satellite and geosynchronous satellite?3
3. a) Derive general link equation. Find expressions for $\mathrm{C} / \mathrm{N}$ and G/T ratio.
$4+2+2$
b) An earth station antenna has a diameter of 30 m , has an overall efficiency of $68 \%$ and is used to receive a signal at 4150 MHz . At this frequency, the system noise temperature is 79 K , when the antenna points at the satellite at an elevation angle of $28^{\circ}$. What is the earth station $\mathrm{G} / \mathrm{T}$ ratio under these conditions ? If heavy rain causes the sky temperature to increase so that the sys noise temperature rises to 88 K , what is the new G/T value ? What are your observations ? $3+3+1$
4. State Kepler's law of planetary motion and explain them.

A satellite is in a 322 km high circular orbit. Determine
a) Orbital velocity in meters per second
b) The orbital period in minutes.

Given average radius of the earth is 6378 km and Kepler's constant has the value $3.986 \times 10^{5} \mathrm{~km}^{3} / \mathrm{s}^{2}$. $9+6$
5. a) Explain look angles and sub-satellite point. $6+1$
b) Derive expression for elevation angle. 5

CS / M.TECH (ECE) / SEM-2 / MCE-205-A / 2011

c) What do you mean by slant range ? Explain\&with the help of diagram. For a GEO satellite it is given a minimum elevation angle of $5^{\circ}$, the maximum slant range $d=41127 \mathrm{Km}, \mathrm{c}=3 \times 10^{5} \mathrm{Km} / \mathrm{s}$.
Find the satellite round trip delay.
6. a) Explain Transponder with the help of block diagram. How many types of transponders do you know ? Illustrate them. $3+4$
b) What is an inter-modulation noise ? Derive the expression for it. How can it be avoided ? $2+5+1$
7. Write short notes on any three of the following :
$3 \times 5$
a) GPS
b) VSAT
c) MSAT
d) Satellite subsystems
e) Satellite launching techniques
f) TDMA burst structure.
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