B.E | VIII | Rev | EXTC | Satellite Communication | June 05

Con. 2660-05. AM-10072

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory.**
(2) Answer any **four** questions from remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume **suitable data, if necessary.**

1. Answer the following ;— 20
   (a) For an eccentric elliptical satellite orbit with an apogee and perigee points at a distance of 50000 km and 8000 km respectively from the center of earth. Determine the semi-major axis, semi-minor axis and the orbit eccentricity.
   (b) A satellite moving in a highly eccentric orbit having the farthest and closest points as 35,000 km and 500 km respectively from the surface of the earth. Detemine the orbital time period and the velocity at the apogee and perigee points, assuming Rearth = 6360 km.
   (c) A paraboloid dish antenna having a diameter of 20 m and an aperature efficiency of 90% produces a radiated beam with solid angle of 3×10^{-4} steradians. Determine the antenna's power gain in dbs and the operational frequency.
   (d) In a certain satellite communication link, the uplink carrier to noise ratio (C/N)u is 25 dB whereas the downlink carrier-to-noise ratio (C/N)d is 20 dB. Find the link carrier-to-noise ratio (C/N).

2. (a) State and explain Keppler's laws for planetary motion. 8
   (b) Explain the term earth eclipse of an earth-orbiting satellite. Why is it preferable to operate the satellite positioned west rather than east, of earth station longitude ? 8
   (c) For a satellite a transmission El = 22°, R0·01 = 15 mm/h, ho = 600 m, hR = 1500 m and horizontal polarisation is used. 6
   Calculate the rain attenuation for a signal frequency of 14 GH_2.

3. (a) Differentiate between the cross-polarisation discrimination and polarization isolation. 6
   (b) Describe the depolarisation caused by rain. 4
   (c) Derive the expression to show that a satellite launched into a circular orbit at a height of H meters from the surface of the earth will move with a velocity V is $v = R\sqrt{g/(R+H)}$, 6
   where g-gravitational constant
   R-Radius of earth.
   (d) Why are the polar orbits not used in communication satellite orbits ? Which are most commonly used satellite orbits ? 4

4. (a) A satellite has transmitting power of 25 W at a frequency of (i) 4GHz (ii) 11·5 GHz via an antenna of 18 dB Gain. An earth station in the network uses an antenna of 12 m diameter with an efficiency of 65%. Determine Gain of antenna used in earth station, path loss and the flux density at the earth station assuming the satellite-earth station range to be 40000 km. Also find the power received at the output of the earth station antenna. Compare and comment upon the results at 4 GHz and 11·5 GHz frequencies. 12
   (b) With the help of neat diagram explain the various ALOHA schemes. 8
   State merits and demerits of each schemes.

5. (a) Dsicuss in brief the major techniques of a satellite attitude control. 8
   (b) A satellite is required to provide 2 kW of power at the end of 15 years of lifetime. Determine the beginning-of-life power of the Solar array, stating the assumptions made. 8
   Assuming a conversion efficiency of 20% and an average solar power of 137 mW/cm², what should be size of the solar array for—
   (i) Sun-tracking body-stabilized (ii) Spin-stabilized satellites ?
   State clearly and justify the assumption made. 4
   (c) Explain in brief the elements of a feed system in earth station.

6. Write short note on the following (any **four**) :— 20
   (a) Sun-syncrhonous orbit.
   (b) Frequency Allocations for satellite services.
   (c) Transponders.
   (d) Intermodulation noise.
   (e) Code-Division Multiple Access.
   (f) Link budget calculations.

7. (a) Discuss in brief the general configuration of an eath station. 6
   (b) Determine the TDMA capacity of a 4 GHz link with the following characteristics— 8
   Satellite EIRP = 22·5 dBW
   Path loss = 197 dB
   G/T of earth station = 30 dB/k
   Total link margin = 5 dB
   Required downlink Eb/No =
   (c) Define the traffic distribution, cove... ...lity of services and spectrum ... for LEO and GEO satellite. 6