ARAB ACADEMY FOR SCIENCE AND TECHNOLOGY
ELECTRONICS AND COMMUNICATIONS DEPARTMENT
SATELLITE COMMUNICATIONS EC723
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1. Briefly answer each of the following questions.

   (a) State one advantage and one disadvantage of using a raised cosine function as a line coding (in comparison to a sinc waveform).
   (b) State one advantage and one disadvantage of noncoherent detection over coherent detection.
   (c) What type of modulation would you recommend for low rate communication to a satellite in deep space, and why?
   (d) What type of modulation would you recommend for high speed data communication over a one kilometer long pair of copper twisted wires, and why?
   (e) Compare between LEO, MEO, and GEO with respect to their advantages and disadvantages for a global satellite telecommunications network that carries voice, video, and data using six different parameters (e.g. distance).
   (f) If you can choose between two filters with rolloffs of 0.4 and 0.8, which one would you choose to minimize the signal bandwidth? What would be the drawbacks?

2. Make a sketch, as neatly as possible , of a satellite and its orbital path around Earth with the following Keplerian elements: a=10,000 km, e=0.2, $M=0^o$, $i=40^o$, $\Omega=30^o$, $\omega=80^o$

3. Assume a satellite rotating in an orbit with an eccentricity of $15x10^{-2}$. The orbit has an inclination, $i=30^o$, and a semi-major axis of $9x10^3$ km. Determine:
   a) The orbital period of the satellite,
   b) The apogee height,
   c) The perigee height and
   d) The satellite's true anomaly at an epoch when its height above ground is measured as $2.2x10^3$ km during a south-to-north transit.

4. Consider an 8−ary QAM system with the following signal coordinates relative to an orthonormal basis $\{\phi_1, \phi_2\}$: (±A, 0), (±3A, 0), (±A,±2A). The signals are sent with equal probability, and are corrupted by AWGN with two-sided power spectral density $No/2$.
   (a) Sketch the maximum likelihood decision regions on the following signal coordinate diagram.
   (b) Find the average symbol energy and the average energy per bit in terms of A^2.
   (c) If the signal at (A, 2A) was transmitted, find a union bound on the probability of symbol error.
   (d) For the maximum likelihood receiver, find the exact maximum symbol error probability with respect to A, N_o, and the Q function.

5. The range of a satellite is 38,000 km. The atmospheric attenuation is 2.5 dB; losses due to polarization mismatches are 0.7 dB. The transmitting satellite antenna has an effective aperture of 1000 cm^2 and radiates a power of 2 W. The ground antenna has a diameter of 20 m and an aperture efficiency of 65%. The LNA is directly attached to the lossless feed of the antenna and has an equivalent input temperature of 42 K and a gain of 32 dB. The receiver is behind the LNA and directly connected to it. The receiver has a noise figure of 8 dB and a gain of 23 dB. Compute the C/N ratio at the LNA input for a system noise bandwidth of 44 MHz. Compute the C/N ratio at the receiver output.

Good Luck
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