TD1
Advanced digital communication

Exercice 1
A communication system uses a bandwidth of 50 MHz and achieves a data rate of 10 Mbps.
- Calculate the spectral efficiency of this system.

Exercice 2
A communication channel has a signal power of 10 mW and a noise power of 1 mW. Calculate the signal-to-noise ratio (SNR) in decibels (dB).

Exercice 3
In a TDMA system, if 1,000,000 bits are transmitted with a BER of 0.001, how many bits are received in error?

Exercice 4
In an FDMA (Frequency-Division Multiple Access) system, each user is allocated a frequency band of 200 kHz, and the total system bandwidth is 10 MHz.

1. How many users can the system support?
2. What happens to the number of users if each user's frequency band is reduced to 100 kHz?
3. If guard bands of 10 kHz are required between each user's frequency band, how many users can be supported in the original 10 MHz bandwidth?
4. If each user's data rate is 50 kbps, what is the total data rate for all users in the system?
5. Given a Signal-to-Noise Ratio (SNR) of 15 dB, calculate the maximum data rate that a single user can achieve using the Shannon-Hartley theorem.
6. With the above SNR, what is the total data rate the system can achieve for all users?

A guard band is a small, unused frequency range between adjacent channels, designed to prevent interference.

Exercice 5
The system operates over a total bandwidth of 20 MHz and employs 16-QAM (Quadrature Amplitude Modulation) with a spectral efficiency of 4 bps/Hz. The network experiences additive white Gaussian noise (AWGN) with a noise power of 1 mW. The system handles a total of 10 channels.

1. Calculate the total system capacity in terms of data rate.
2. Determine the maximum number of users the system can support simultaneously if each user is allocated a data rate of 2 Mbps.
3. Calculate the SNR (Signal-to-Noise Ratio) if the signal power is 10 mW.