

Data Communication Tutorial 01.P2

Data Transmission

1. Differentiate between an analogue and a digital electromagnetic signal.
2. If the solid curve in Fig. 1 represents $\sin(2\pi t)$, what does the dotted curve represent? That is, the dotted curve can be written in the form $A \sin(2\pi f t + \psi)$; what are A , f and ψ ?

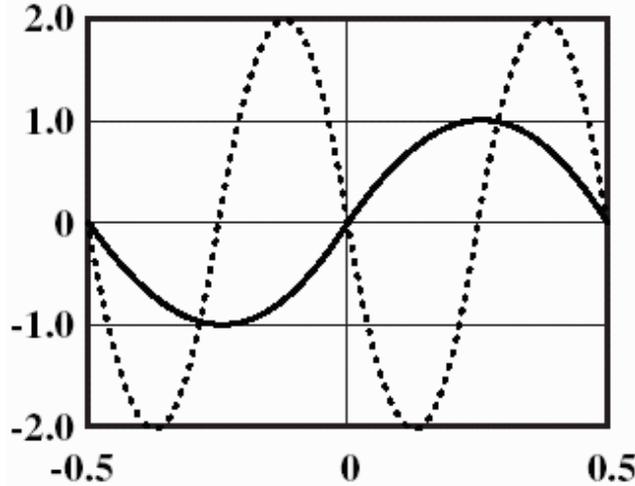


Fig.1.

3. A periodic signal completes one cycle in 1 ms. What is the frequency?
 4. A device is sending out data at the rate of 1000 bps.
 - a) How long does it take to send out 10 bits?
 - b) How long does it take to send out a single character (8 bits)?
 - c) How long does it take to send a file of 100,000 characters?
 5. Sound may be modelled as sinusoidal functions. Determine the wavelength of a musical note F that has frequency 352 Hz. Use 330 m/s as the speed of sound.
 6. Express the following in the simplest form you can:
 - a) $\sin(2\pi f t - \pi) + \sin(2\pi f t + \pi)$
 - b) $\sin(2\pi f t) + \sin(2\pi f t - \pi)$
- Hint: Use the sine addition/subtraction formula: $\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$*
7. Find the period of the function $f(t) = (10 \cos t)^2$. *Hint: Use the identity for $\cos a \cos b = (1/2)(\cos(a + b) + \cos(a - b))$.*
 8. What key factors affect channel capacity?
 9. What does a decibel measure?



10. What is the channel capacity for a *telex* channel with a 400-Hz bandwidth and a SNR of 3 dB? (Note: Telex is a communications system, which links electromechanical typewriters that either transmits or receives messages coded in electrical signals.)
11. A digital signalling system is required to operate at 24 Kbps (i.e. 24 000 bps). If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?
12. The attenuation of a signal is -10 dB. What is the final signal power if it was originally 5 W?
13. A signal is passed through three cascaded amplifiers, each with a 4 dB gain. What is the total gain? How much is the signal amplified?
14. What does the Shannon capacity have to do with communications?
15. We have a channel with a 1 MHz bandwidth. The SNR for this channel is 8.45 dB. What are the maximum achievable capacity and the required signal levels to meet this capacity?
16. The frequency domain function for a square wave will reveal that an infinite number of higher frequencies of decreasing magnitudes are needed to represent such a signal. What implication does that have for a real digital transmission system?
17. Suppose that a digitised TV picture is to be transmitted from a source that uses a matrix of 480×500 picture elements (pixels), where each pixel can take on one of 32 intensity values. Assume that 30 pictures are sent per second. (This digital source is roughly equivalent to broadcast TV standards that have been adopted.) Find the source rate R (bps).
18. Assume that the TV picture is to be transmitted over a channel with 4.5-MHz bandwidth and a 35-dB signal-to-noise ratio (SNR). Find the capacity of the channel.