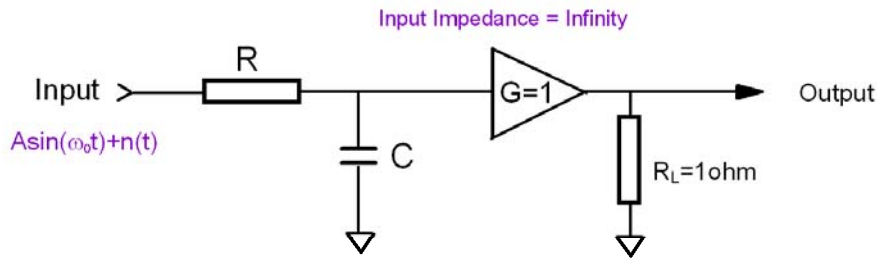


EE3101 Communication Engineering

Tutorial 3

- (1) (a) What is the power output of a sine wave with amplitude A (assume 1Ω loading) and angular frequency ω_0 ?
- (b) Consider to use the following **RC** network to maximize the output S/N . Assume the input is a sinusoidal signal with angular frequency ω plus White Gaussian noise with double-sided power spectral density of $\frac{N_0}{2}$. Find the value of the **RC** product in terms of ω_0 such that the output S/N is a maximum.

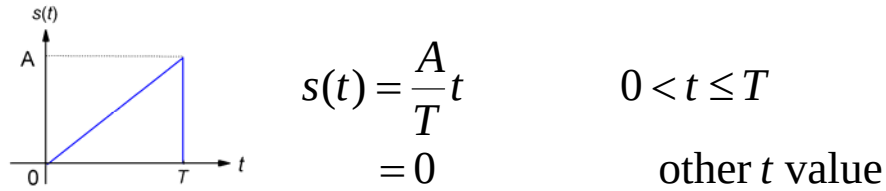
Note :
$$\int_{-\infty}^{\infty} \frac{dx}{1 + (x/a)^2} = \pi a$$



- (2) Consider a Bipolar **NRZ** signal in a zero mean Gaussian noise channel. The transmission power is P and the prob of error is 10^{-6} .
- (a) What is the prob of error if the transmission power is doubled to $2P$?
- (b) What is the prob of error if the format is changed from Bipolar NRZ to Unipolar NRZ and with the same transmission power P ?

Note:
$$Q(x) \cong \frac{\exp(-x^2/2)}{x\sqrt{2\pi}} \left[1 - \frac{1}{x^2}\right] \text{ for } x > 3, \text{ and } Q(4.753) = 10^{-6}$$

- (3) Consider that the following triangular waveform $s(t)$ is used to represent the binary “1” and T is the bit duration. Assume that an ideal matched filter is used at the receiver.



- Sketch the impulse response $h(t)$ of the matched filter for $s(t)$.
- Derive the equation for $h(t)$, and hence show that the output of the matched filter for $0 < t \leq T$ can be expressed as:
 $Bt^2[1 - \frac{t}{3T}]$ where B is a constant, determine its value.
- Derive the output of the correlator for $0 < t \leq T$.
- Find the output of the matched filter and the correlator when $t = T$.