DIGITAL COMMUNICATION

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Sampling

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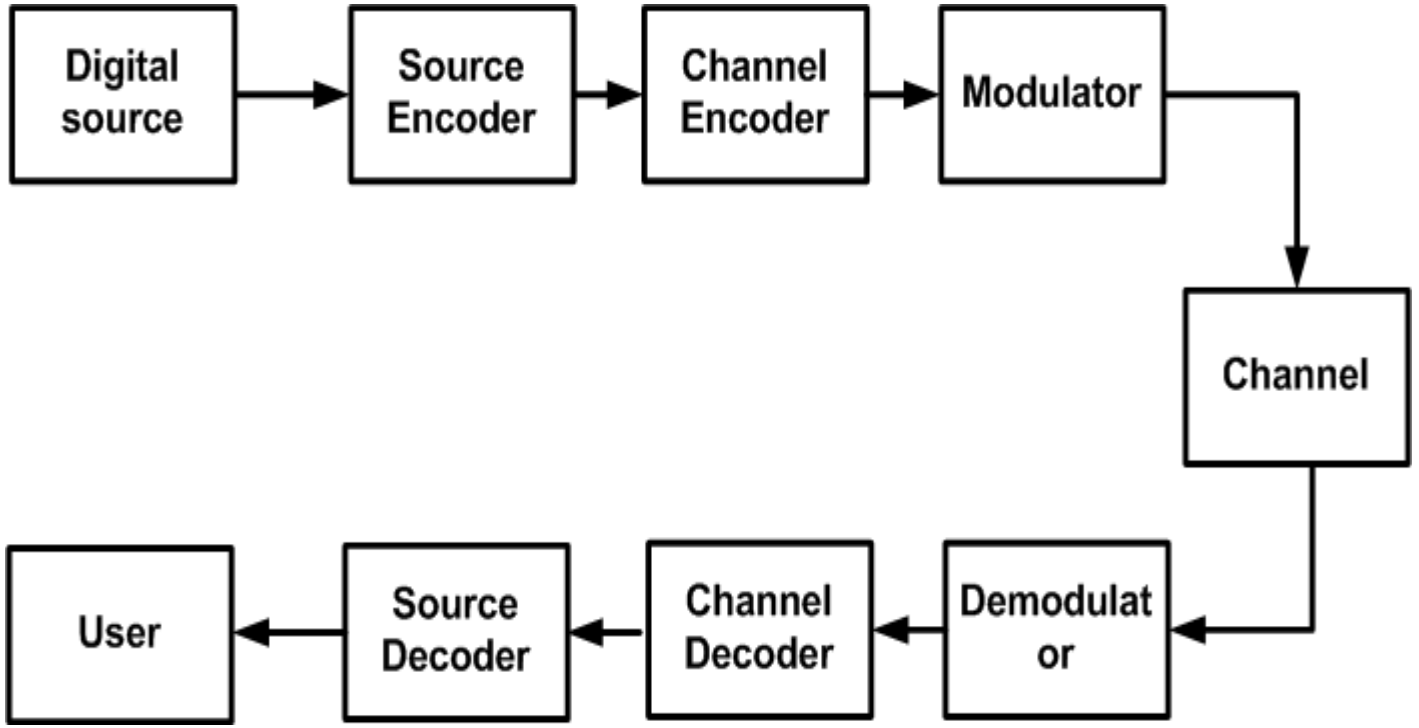
Sampling

Outline

- Sampling Theorem
- Quadrature Sampling of band-pass signals
- Practical aspects of sampling and signal recovery
- Sample and Hold circuit for Signal recovery
- Time Division Multiplexing

Digital Communications (Ch -4)– Simon Haykin

Digital Communication System



Basics of Sampling

What is sampling?

- Converts analog signal into discrete time signal.
- To transmit analog signal using digital communication system analog signal should be sampled.
- Sampling rate is determined by bandwidth.
- Sample values are analog in nature.

Sampling Theorem

- g(t) - Continuous time signal
- Dirac delta function is $\sum_{n=-\infty}^{\infty} \delta(t - nT_s)$

  Ts – spacing between samples
- Sample values of the signal are $g(nT_s)$

$$g_\delta(t) = g(t) \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$$

$$g_\delta(t) = \sum_{n=-\infty}^{\infty} g(nT_s)\delta(t - nT_s)$$

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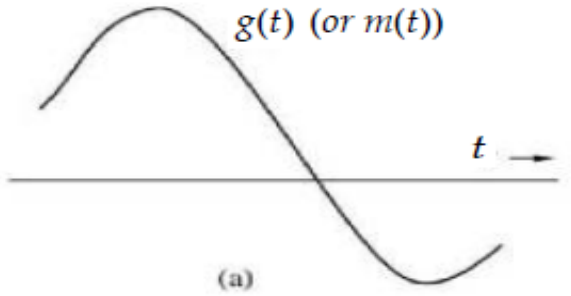
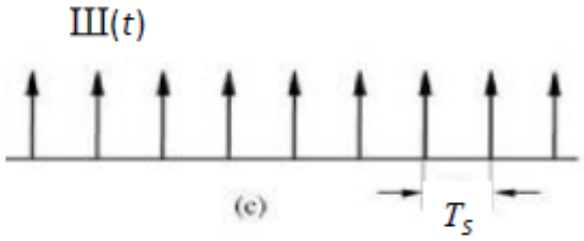
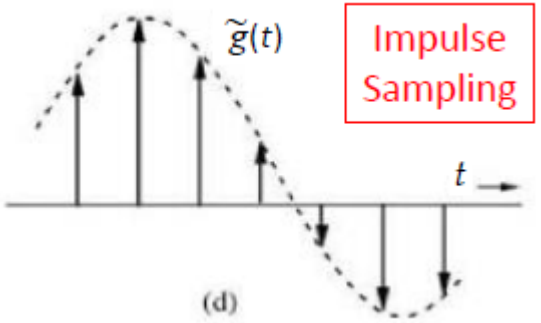
Sampling Theorem



g(t) - Continuous time signal



III(t) – Dirac comb signal



$\tilde{g}(t)$- product of g(t) and III(t)

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Sampling Theorem

- FT{g(nTs)} = $G_\delta(f) = G(f) * FT\left\{\sum_{n=-\infty}^{\infty} \delta(t - nT_s)\right\}$

$$= G(f) * \frac{1}{T_s} \sum_{k=-\infty}^{\infty} \delta(f - kf_s)$$

$$= \frac{1}{T_s} \sum_{n=-\infty}^{\infty} G(f - nf_s)$$

- FT of $g_\delta(t) = \sum_{n=-\infty}^{\infty} g(nT_s)\delta(t - nT_s)$

$$G_\delta(f) = \sum_{n=-\infty}^{\infty} g(nT_s)e^{-j2\pi fnT_s}$$

Sampling frequency $f_s = 2w_m$

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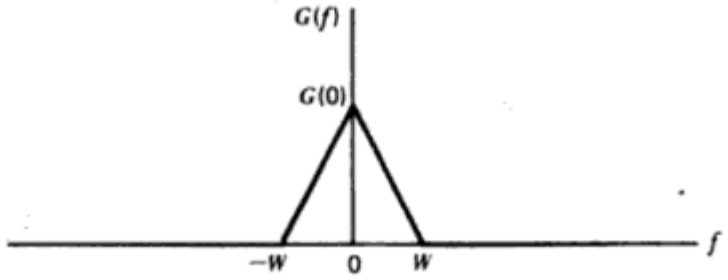
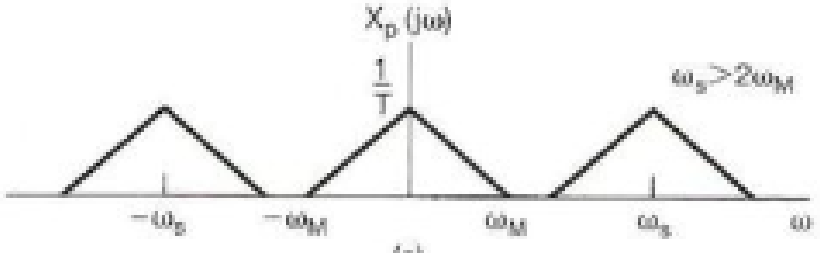
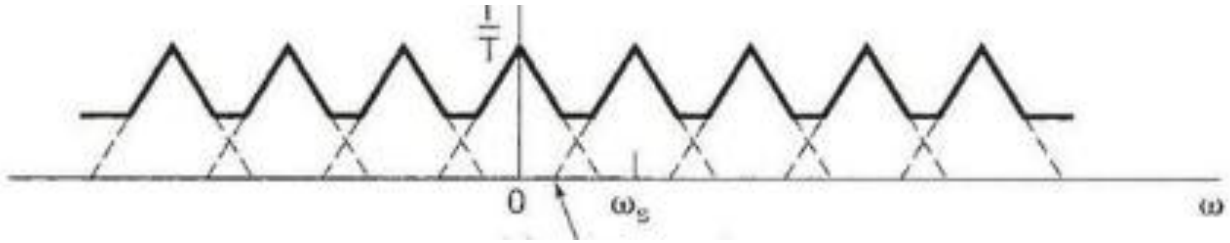
Sampling Theorem







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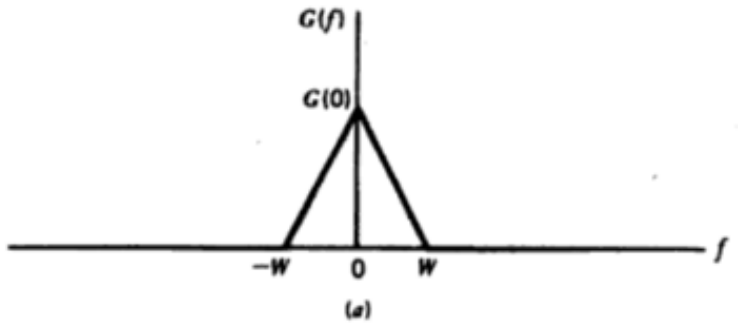
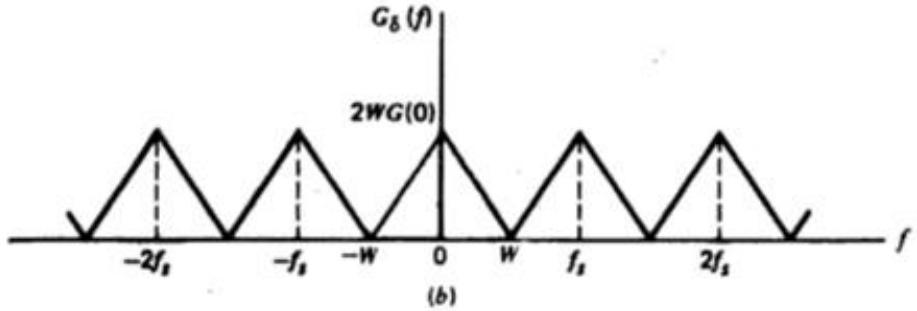
Sampling Theorem



(a)



(b)