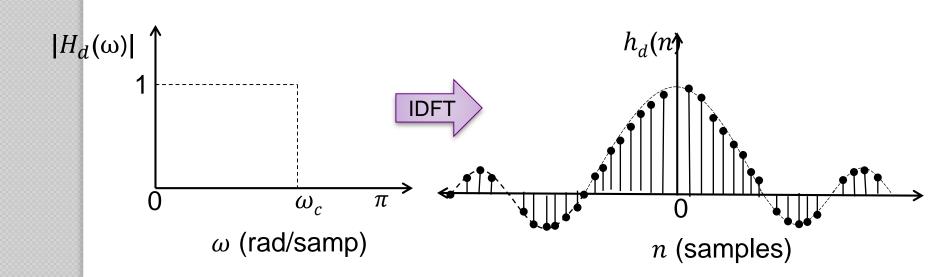
Digital Signal Processing (EE313): FIR filter design using windowing

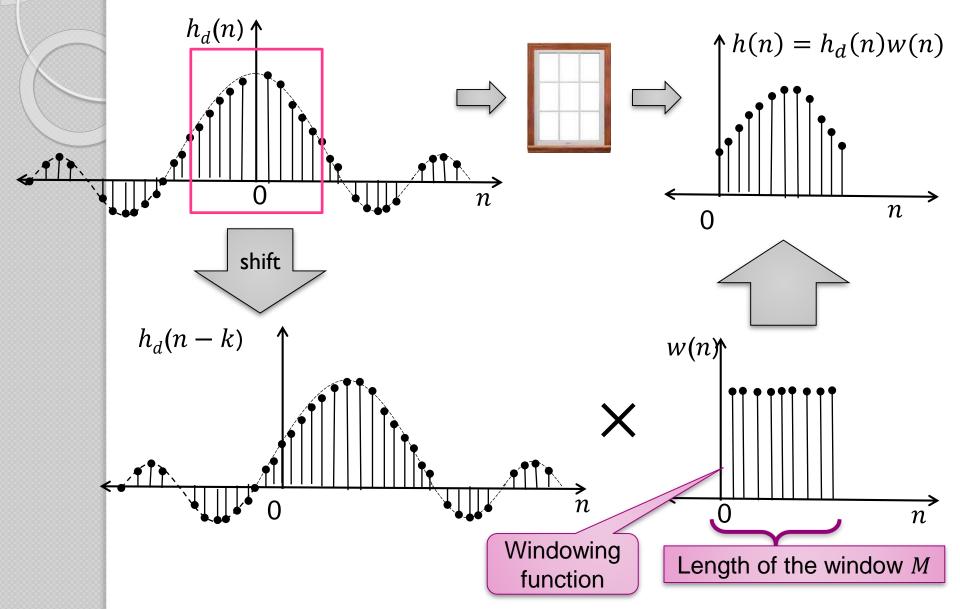
Krishnan C.M.C Assistant Professor, E&E, NITK Surathkal

Design using windows:

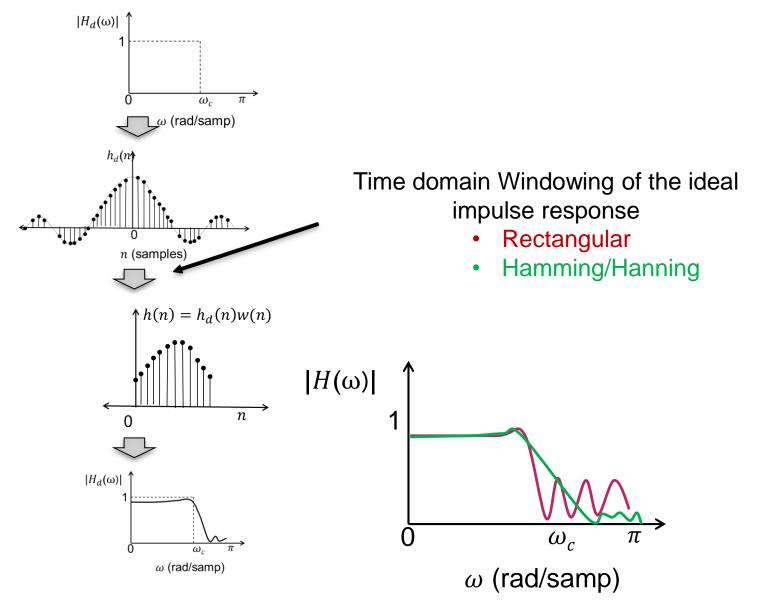
- Starts from a desired frequency response (mostly ideal response)
- Ideal response is:
 - acausal
 - stays for infinite duration



Design using windows:



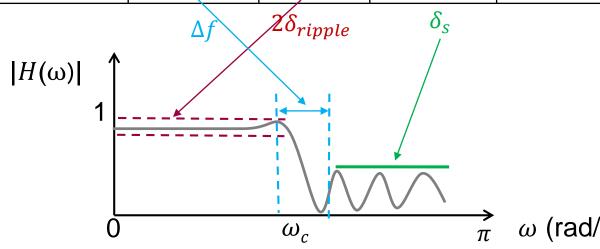
Design using windows:



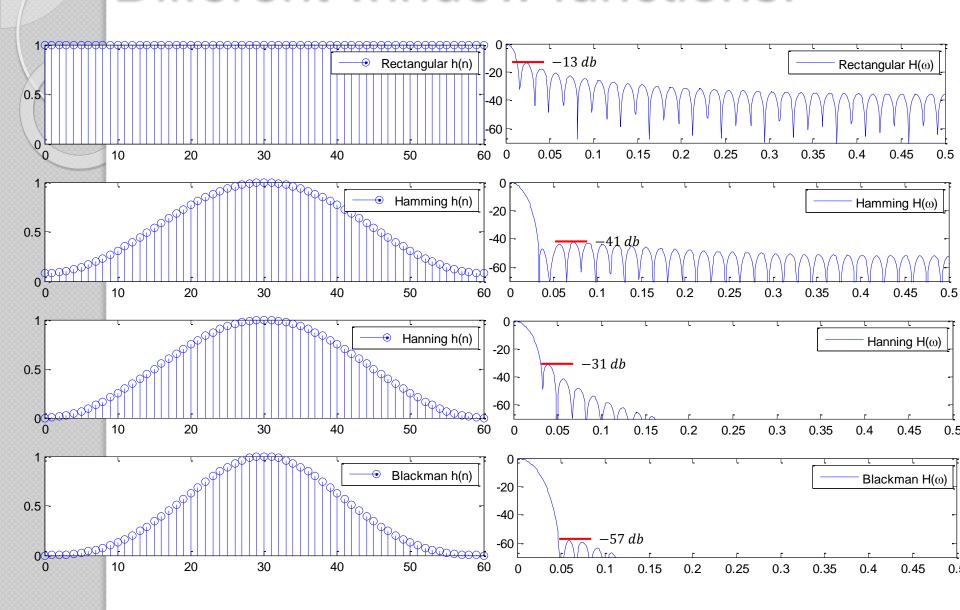
Different window functions:

Window Properties

Window	Transition width (Hz) normalized	Pass band ripple	Stop band attenuation	Time-domain sequence $0 \le n \le M-1$
Rectangular	<u>.9</u> <u>M</u>	.07416	21	1
Hanning	$\frac{3.1}{M}$.0546	44	$.55 \cos\left(\frac{2\pi n}{M-1}\right)$
Hamming	$\frac{3.3}{M}$.0194	53	$.5446 \cos\left(\frac{2\pi n}{M-1}\right)$
Blackman	5.5 M	.0017	75	$.425 \cos\left(\frac{2\pi n}{M-1}\right) + .08 \cos\left(\frac{4\pi n}{M-1}\right)$



Different window functions:



FIR Filter design flow chart:

Design specification in the analog domain

$$\omega = \Omega T$$

Convert to digital domain using sampling

Decide window based on δ_s

$$\omega_c = \frac{(\omega_p + \omega_s)}{2}$$

Find the ideal ω_c and $H_d(e^{j\omega})$

Find *M* from the table (checking the transition width)

$$\alpha = \frac{M-1}{2}$$

Find the ideal impulse response $h_d(n) = Inverse\ Fourier \left\{ e^{-j\alpha\omega} H_{d(e^{j\omega})} \right\}$

Find the practical impulse response $h(n) = h_d(n) \times w(n), n = 0,1,2,...,M-1$